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THE

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THE PHYSICAL CONDITION OF THE BRITISH RACE.

THE discussion which took place recently in the House of Lords upon the subject of physical training, shows that some of our statesmen have at last awakened to a matter of racial importance. The Earl of Meath having asked whether a Royal Commission or Committee of Inquiry could not be granted to investigate the influence of town life upon the poorer classes of our population, the Bishop of Ripon called attention to the fact that the size of families has decreased from 4·3 to 3·2 during the past 20 years, so that if the present rate of fall in the increase of population should continue for another 15 years, the number of inhabitants would remain stationary. In reply, the Duke of Devonshire announced that the Secretary of State for War had been in communication with the Home Office and the Local Government Board, who agreed that searching inquiry was necessary; it was proposed first to refer the subject to the medical profession, in order to ascertain the best methods of gaining information, and afterwards probably to create a Royal Commission.

It is clear that we have here two distinct matters for consideration: (1) The diminution in growth of the population; (2) its deterioration in quality. Most civilised nations apparently show the first phenomenon more or less clearly—even our own Colonies, where there is room enough and to spare for the people. Every thoughtful man admits the seriousness of the position; but many put it outside the domain of practical politics, alleging that, as it is alternatively a symptom of physiological decay in the nations, or a matter of so intimate a nature between each man and wife, it must be accepted as inevitable. We are prepared boldly to deny the accuracy of the former apology, and to question whether it is beyond the wit of statesmen to devise a roundabout scheme for encouraging the growth of families in certain conditions in a manner which should produce the desired effect of increasing number and quality without interfering with the "liberty of the subject" or offending the straitest canons of modesty. This, however, is merely by the way; the deterioration in quality of the race is a more practical question, which should be more amenable to attack; and it should be possible to effect vast improvements in that direction by proper application of money without even approaching the difficult problem of sex relationship.

It is not so easy for us of the British Empire to obtain trustworthy figures showing the deterioration of the race, as it is for the inhabitant of a foreign country where universal military service is the law. The recruiting data of France and Germany apply to the whole population of those countries; ours to only the lower classes. Still, it is undoubted that degeneration has set in, and it must be stopped, not so much for military reasons as because the

more important industrial army is suffering. Members of the Anglo-Saxon race always seem peculiarly liable to rush to extremes, and we have a case in point. The son of the higher and upper-middle classes of society, who enters upon life generally endowed with a sound constitution and good muscular development, is permitted and encouraged by his parents, schoolmasters, and the feeling of the country to neglect his intellectual education throughout his youth, and to devote himself almost exclusively to sport. The son of the lower classes, who enters upon life handicapped by a congenital tendency (perhaps) to drink, to crime, and to disease, but who might be developed into a healthy citizen under the "educational" systems of our large public schools and universities, is compelled by the voice of the country to devote himself during the physiologically critical period of his existence to the acquisition of book learning for which he is unfitted, and which, in consequence, does him little or no good. It is the son of healthy parents who ought to be made to study, and the son of poor (*i.e.*, usually of unhealthy) parents who ought to be made to play cricket and football—and this quite apart from the law of heredity, which teaches that the former would more often pay for the intellectual education than the latter, and the latter respond more noticeably to the physical training than the former.

The reason why we are writing in this strain at the present juncture is this:—We have before us, primarily as Londoners, secondarily as citizens of the United Kingdom or British Empire, a magnificent scheme for the creation of a new Technical University for the metropolis. We have already expressed our approval of the proposal, and our belief that if successful the enterprise will prove of very great benefit to the nation. But such a university can, by its very nature, benefit only a limited number of the population; partly because only a limited number of youths possess the latent mental capacity to take advantage of it, and partly because we must always require in commerce and industry huge numbers of boys and men who are no more valuable for having specialised knowledge, and who are only useful because of their common intelligence or their physical strength. Lower down the intellectual scale, we have institutions and schemes for providing so-called technical instruction, which may now and then be valuable by unearthing some lad who afterwards pays for more systematic education, but which, generally speaking, are of small direct use; and still lower down we have the free library, the creation of which appears to have become almost epidemic. *Mutatis mutandis* we regard the free library and the polytechnic much in the same way; they are admirable devices for keeping the juvenile population off the streets and out of the public houses; but we seriously question their educational value, especially that of the library. A free library may or may not contain all the best books; but even if it does, only a limited number of its frequenters study them. Free libraries have been attacked recently in one of our reviews on the ground of their demoralising influence, due to the presence of the inane literature which must be provided to please adult ratepayers, and which the youths peruse. Still it may be argued that a constant perusal of halfpenny "comics" is less harmful than gambling in a back street, or an evening in the only cheerful sitting room available—at the gin palace.

Nevertheless, all these establishments have the defect of appealing—to whatever extent they do appeal—to the intellectual side of the probably non-intellectual youth. Every boy and girl without exception is the better for physical training, and the result of that training descends in its entirety to future generations; only some young persons are the better for education, and only a very limited portion of the results is more than individual. We are often told (perhaps by theorists only) that the fatal objection to becoming a millionaire—an objection which removes from that position any advantage it might otherwise possess—is the extreme difficulty of finding anything to do with one's surplus money. Any philanthropic scheme, it is said, does someone harm, or "pauperises" somebody. The "pauperisation" argument is surely rather silly: we have already agreed to pauperise everybody who is willing to be so treated by our method of free elementary education, and the nation does not seem to revolt. We would humbly suggest to our would-be philanthropists that there are methods without number for applying their money, methods better than that of founding free libraries for the subsidising of the gutter Press, methods better than those which create the shop lawyer or even the physically-rotten man of some talent. They might investigate and finance the better conducted of those struggling institutions which are already striving to educate physically as well as mentally the poor children of the slums, investing their money (to put the matter on the lowest footing) in the health and muscle of the next generation. They might found and endow new establishments where children might be rescued entirely from their ignorant and criminal parents, and be brought up strong labourers and artizans, and where vicious and diseased habits should be eradicated from the infants. And thus while doing their share to stem the tide of physical deterioration, and to produce the "Imperial Race" worthy of the Empire which Lord Rosebery desires, they would relieve the ratepayer from part of his heavy obligations, leaving him more money wherewith to educate his family to the utmost possible extent.

Radio-activity and the Cure of Consumption.

A COMMUNICATION by Mr. Frederick Soddy to the *British Medical Journal* of July 25th, probably marks the beginning of a new era in the treatment of consumption. It has been demonstrated by the experiments of Mr. Crookes and others, that the radiation from radium is a very powerful germicide. Mr. Soddy shows how easy and simple is the application of this radiation to the diseased tissues of the lungs, by the inhalation of the emanation from radium, or the very similar emanation from thorium. The emanation from radium is the more powerful of the two, but it has the disadvantage of being very slowly given off by the salt. For instance, when the whole of the emanation has been inhaled, it will take three weeks for the salt to reproduce an equal quantity. Thorium, on the other hand, will reproduce its emanation in five minutes; and though less powerful, the emanation from thorium appears to be best adapted for medical application. The emanations from both radium and thorium excite a secondary radio-activity on the surfaces with which they come in contact. This tends to prolong the germicidal action. This secondary activity lasts in the case of thorium for two days, but only for three or four hours in the case of radium. Directions are given by Mr. Soddy how

best to produce and apply the emanations of these radio-active substances. It remains for medical men to determine whether the new treatment can be applied without injury to the patient. All our previous knowledge of the properties of radio-active substances leads us to expect the most favourable results. To quote Mr. Soddy :—"The immunity of these processes from external interference, the simple nature of the treatment proposed, the infinitesimal quantity of the active agents employed, the manner in which the emanations may be inhaled to do their work at the very seat of the disease, leaving behind in their place the excited activity to continue the work in a gentle manner after they have been exhaled, make out a strong case why the attention of medical men should be directed to these new weapons which physics and chemistry have placed at their disposal."

The I.E.E. Building Fund.

THE upshot of the meeting held on Friday last was precisely what we had anticipated. About a couple of dozen members assembled in the library at the offices of the Institution ; the notice calling the meeting was read, the President very briefly explained the position and nature of the site, the motion was put, seconded, and carried. The proceedings were so brief that a member, arriving ten minutes late, was just in time to hear the announcement of the adjournment of the meeting, after a vote of thanks had been passed to the Building Committee.

Considering the day and hour selected for the meeting (4.30 p.m. on the Friday before Bank Holiday !), the brevity of the notice calling the meeting, and the meagre information imparted to the meeting with regard to the transaction, we cannot help looking upon the proceedings as very unsatisfactory.

Doubtless the investment will prove a profitable source of income, though presumably the purchase price is that of the open market ; as the deal is not yet consummated, full particulars on this score are not at present obtainable. But we are concerned less with the merits of the transaction than with the manner of its execution, which appears to us highly objectionable.

It must be many years before the site is utilised for its ostensible purpose ; in the meantime, we commend the idea of a Central Engineering Institution to the consideration of the members of the I.E.E. That such a scheme is worthy of consideration needs no demonstration, for it has already received, and is now receiving, careful consideration in other centres of engineering. The main point is that *now* is the time for discussing the matter, so that if it is found desirable, when the opportunity arrives we shall be ready to take full advantage of it. The benefits derivable from the adoption of a joint scheme, in the shape of convenience and economy, the furtherance of social and commercial intercourse, the improved standing and influence of the allied engineering societies at home and abroad, and many attendant possibilities such as bureaus for employment and general information, &c., will readily be appreciated. Surely the electrical engineer will instantly grasp the importance of improving the load factor and the diversity factor of the buildings !

London Electrical Contractors' Association.—At the annual general meeting of the London Electrical Contractors' Association, held at Frascati's Restaurant on the 27th ult., the President, Mr. Rashleigh Phipps, in the chair, the annual report and balance-sheet was submitted and adopted, and the following officers appointed for the ensuing year:—President: Mr. E. L. Berry; Vice-Presidents: Messrs. W. Duncan, W. W. Strode, and C. L. Troup; Council: Messrs. Gillard, Joseph, Lund, Marryat, Mossop, Tate, Tomlinson, Tricket and G. F. Ratcliff; Honorary Treasurer: Mr. W. R. Rawlings; Honorary Secretary: Mr. E. J. Hogan. Among other business, it was decided to hold a series of monthly general meetings for the discussion of subjects of interest to the contracting trade. Any contractors in London and district who have not yet joined the Association are requested to communicate with the hon. sec., Mr. E. J. Hogan, 141, Fenchurch Street, E.C.

THE DEVELOPMENT OF THE CURRENT INTERRUPTER.

By J. WRIGHT.

(*Concluded from page* 204.)

A SOMEWHAT unique form of electrolytic interrupter, in which materials immediately to hand have been utilised in making up the complete apparatus, is that of J. Härden, illustrated in fig. 15. L is a cylindrical lead containing-vessel forming the cathode, and surrounded by a water-

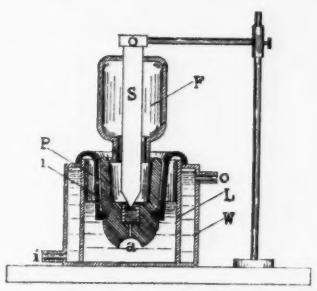


FIG. 15.

jacket W, through which a constant circulation of cold water is kept up by way of the inlet and outlet pipes, *i* and *o*. Inverted in this cylinder, and held in position by a lead ring, *l*, and supporting flange, is an ordinary porcelain insulator P, with the stem removed. A small hole, *a*, is drilled through the top of the insulator, which, with the containing vessel, L, is filled with an electrolyte of dilute sulphuric acid. S is a lead strip forming the anode, supported on a lead-coated brass stand, as shown, by means of which its height, in regard to the level of liquid in P, can be regulated at will. F is an ordinary wide-mouthed flask, inverted over P, and having an opening cut in its base to permit the passage of the anode S ; its object is to prevent splashing or spurting of the acid electrolyte. A frequency of from 70 to 80 per second is obtainable with this device, and it is said to have yielded highly satisfactory results over a practical trial lasting for some weeks.

Messrs. Goldhammer and Ariston's modification of the Simon interrupter consists in substituting specially prepared porcelain beakers for the glass test tube adopted by Simon in the original form of interrupter devised by him. The walls of the beakers are thinned down until their thickness is only a few tenths of a millimetre in the immediate neighbourhood of the intended perforation. The latter is finally secured with a needle, which is lightly tapped through by a hammer, yielding an opening from 2 to 4 millimetres in diameter. Heating is obviated, or reduced to a minimum by employing two or more beakers in parallel, immersed in the common electrolyte contained in the outer cathodic vessel, and common electrical connection between them is secured by inverted siphons filled with the fluid. A layer of oil is poured in over the upper surface of the electrolyte, and, with the multiple-beaker arrangement, the difference in level of the electrolyte, already commented upon in connection with the simple Caldwell interrupter, is compensated for, in that a rise or fall of level in one of the beakers results in a corresponding displacement of level in the remaining ones, which equalises matters and prevents the usual stoppage due to this cause.

Dr. R. H. Cunningham, to get over the difficulties and drawbacks attendant on the overheating and subsequent fracture of the glass tube surrounding the anode in the original Wehnelt interrupter, constructed a useful pattern in which these disadvantages are obviated, and which is, moreover, capable of interrupting comparatively heavy currents without risk of fracture or burn-out. The containing vessel is of ebonite, with a close-fitting lid, through which pass the two extremities of a lead tube, which latter, coiled spirally inside the vessel, constitutes the cathode, and is, together with the main body of the electrolyte, kept cool by the constant circulation of a stream of cold water through it. An ebonite vent tube is also fitted to the lid, and communicates

by way of a flexible rubber tube with a second vessel containing sponges saturated with a strong solution of soda, which absorbs the acid fumes produced in action. The anode consists of the usual short platinum wire brazed into the lower extremity of a brass rod, the top of which is threaded to receive a regulating nut, and which, thoroughly coated with vaseline, passes vertically upwards through the lid, that portion of it situated within the cell being surrounded by a thick-walled ebonite tube. Into the lower extremity of this latter and immediately surrounding its platinum extension is secured by means of acid-proof cement a lava bushing, which fits tightly around the platinum, and is immune from fracture due to the heat produced at the anode.

A. H. Taylor has substituted carbon for the platinum anode in the Wehnelt interrupter, with a view to cheaper production and interchangeability. His arrangement consists of a cathode lead container, through the lid of which passes a thistle tube surrounding a carbon rod some 3 millimetres in diameter. The latter is copper plated to within a short distance of its active extremity, and rests, by its own weight, in a stirrup attached to the base of the tube; it thus feeds downward regularly as its lower end wears away in action. The electrolyte preferred is a solution of caustic potash, and the minimum voltage required to start the action is 70, somehat higher than that necessary with the original Wehnelt type. The best working E.M.F. is said to be 100 volts. In practice, the electrolyte is forced up the thistle tube into the funnel top of the latter, until it finds a certain level at which equilibrium obtains. It is further claimed that the frequency of interruption may be varied by controlling the depth of electrolyte in the containing vessel.

An electrolytic interrupter of the Wehnelt type, with automatic feed for the anode on a principle similar to the foregoing, has been designed and patented by Dr. C. O. Schneider, of Chicago. It is extremely simple, and possesses the attendant merit of cheapness, in that the platinum anode is replaced by a rod of german silver. A containing vessel for the electrolyte is fitted with a close lid, the centre of which is bushed and threaded to receive a species of gland carrying a vertical glass tube, open at both ends. This latter encircles the german silver anode, more closely at the bottom than the top, but loosely throughout, so that the rod is free to move in it by virtue of its own weight. The anode, or german silver rod, rests on the bottom of the containing vessel, and the area of its surface exposed to the electrolyte is regulated by the threaded gland in the lid, which permits the glass tube to be raised or lowered, thus varying the level of its lower extremity in relation to the base of the vessel, and exposing more or less of the anode as the case may be. The latter wears away to a point in action, and as it is consumed, so to speak, descends by its own weight, thus maintaining a fairly constant area of exposure. The cathode consists of the usual lead plate with a connecting wire passing through the lid.

Prof. A. L. Foley and R. E. Nyswander, of the Indiana University Physics Laboratory, U.S.A., have made a considerable study of the Wehnelt electrolytic interrupter, and find that the cessation of interruption, due to the so-called "fatigue" of the cell, may be overcome by a momentary break and subsequent make of the primary circuit. To provide for this contingency they have devised an automatic mechanism which resembles an ordinary mechanical interrupter, and is designed to open the primary circuit when the electrolytic interrupter ceases to act, and close it again shortly afterwards.

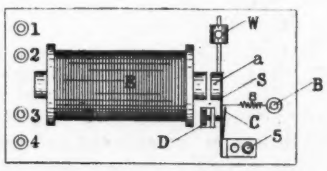


Fig. 16.

The device is represented in fig. 16, and consists of an electro-magnet E, with a laminated core and two sets of coils, brought to four terminals, 1, 2, 3 and 4, arranged on the base of the apparatus. Facing one extremity of the core is a soft-iron armature *a*, attached to the free extremity of a flat flexible spring, S. The armature *a* carries an adjustable weight W, and is assisted at "break" by the spiral spring *s* attached to the standard B. C is the actual contact spring, which makes with the platinum-tipped screw D, and is made to break circuit with the latter by the swing of the spring S and its weight W. The double winding permits of any desired range of adjustment as to the magnetising current, and the apparatus is connected in series with the usual electrolytic interrupter by way of the terminal 5, and one or other of the remaining terminals 1—4.

Normally, the primary circuit is always completed through this apparatus, but, in the event of fatigue setting in, the current through the magnetising coil is diminished, and the spiral spring *s*, coming into action, draws the armature *a* away from the core of the electro-magnet E. The movement set up thereby, accentuated by the inertia of the attached weight W, carries the flat spring S against the actual contact spring *c*, and causes the latter to momentarily break the primary circuit, restoration being effected on the backward swing of the hammer.

The same investigators have studied the action of some 50 different varieties of electrolyte, and find that the addition of nitric acid to the usual sulphuric acid solution lowers the primary voltage required to start the action. A 10 per cent. solution of sulphite of sodium is also recommended for use, *per se*, on a circuit having an E.M.F. in the neighbourhood of 110 volts.

POUR RIRE.

What a sublime being is an inventor! Is there anything not absolutely perfect; is there anything, in fact, which has never been; let it but come under the dreamy eye of the inventor, and, lo! with a twist of that prodigious brain, nothing is any more not perfect, there is nothing that has yet to be!

A leaderette in our issue of September 13th, 1901, drew attention to the most remarkable scheme for the protection of trolley wires which it has been our pleasure to examine either before or since. Nearly two years have passed since that eventful moment, and we can only ascribe to the proverbial cold shouldering of genius the fact that there is not a galvanised iron roof suspended over every trolley wire in the kingdom.

We are more than delighted, however, to find that disappointment has not dulled the inventive energies of the author of that perfect safeguard, and we hail with joy the advent of an age entirely immune from accidents or mishaps of any kind whatever, which must inevitably result from the adoption of the devices set forth in pamphlets recently to hand from that identical wholesale genius.

In order that future ages may not condemn us for a short-sighted generation, and that it shall not be said of this journal, at least, that inventions languished for want of encouragement, we propose to give Mr. Jas. T. Pearson an absolutely free and unsolicited advertisement. This gentleman, moreover, is an electrical and mechanical engineer; he says so himself; and we will never withhold the helping hand from a professional brother.

The only fault we have to find with Mr. Pearson is, that he presents us with no less than six novelties at once, and the fact that a busy man can find time to digest the whole is due to the uniquely interesting style in which these "unique specialities," as Mr. Pearson rightly names them, are described. We say unhesitatingly that had not Mr. Pearson been an inventor of the first water, he must have been an author, so enthralling is his method of composition, and so masterly his treatment of matter which, in other hands, would have been dry.

May we say how utterly impossible it is for ordinary, uninventive people like ourselves to appreciate in an adequate fashion the mental processes involved in thinking out such a device as the warning or alarm bell which is described by Mr. Pearson with almost elaborate detail?

After explaining the necessity for some warning appliance for use on cars, and the benefits which would result, the inventor proceeds:—"The existing bell could be utilised, or another, and hung loose on a short, thin chain to swing

under the car, so as to be struck continually with a flexible striker a few inches long, with a muffled knob, fixed at one end of an axle to swing round with it, about 3 in. long."

How simple it seems when described like that! But we know that they are the simplest things which are the most perfect. Now the language of the inventor becomes almost grandiose, elevated by the ardour of philanthropic genius. "The bells, having the same and a pleasant tone . . . . would be recognised and act as a warning signal, and accomplish the highly desirable consummations indicated above, as the renowned Bell Rock signal has done with its melancholy, but welcome and assuring, reverberating, resonant, sonorous, and penetrating sound to mariners, as it continually tolls . . . . and there is no doubt that there would be less wrecked cars by collisions, and injuries caused, and fewer lives lost in future."

When we have caught snatches of the wondrous music obtained by the motorman by the simple pressure of his clumsy boot, how often have we longed for more! How often have we envied the dwellers in the down-town blocks of such blest cities as New York, where the music of a thousand cars is heard all day! How merrily would our articles go if written to the song of the constant clanging bell! No more will the music-ache of the weary inhabitants of our towns have to be appeased by the gay barrel-organ when Mr. Pearson's invention is applied to every car.

In our brilliantly lighted modern cars the motorman has to be protected from the penetration of much light to the front platform. Let us disclose how Mr. Pearson overcomes this difficulty: "All that is required to obviate this cause of accidents is the familiar spring roller blind now used in railway carriages . . . . and hung *outside* instead of inside, so that the driver can pull them down when he goes into the cab, and by touching them when he goes out they will be automatically drawn up."

Words fail to express our admiration for the man who proposes to make travelling safer by means of hanging an inside blind outside, making it not only waterproof, but attractive and pleasing at the same time. We were not surprised on turning the page to find that "serious injuries to passengers through being jerked off the top of cars also occur . . . . and this objectionable feature can be obviated . . . . by applying the admirable principle of the blinds just described . . . . to allow the passengers to cover the seats when wet, and when rising be automatically drawn under the seat out of the way, and dried immediately by the current of air caused by the motion of the car."

If we read Mr. Pearson aright, the future passenger may sit down on the top of a car and rather enjoy getting wet, because he knows that on rising he will be drawn under the seat and dried without trouble or risk of chills. That being so, we are perfectly willing to believe that "the same advantages, if any (note the inventor's modesty), as those claimed for that prodigious monstrosity . . . . the covered double-deck car can be obtained at one-fifth the cost, and the car is not made top-heavy and liable to be jerked off in a collision, and the passengers with it."

Mr. Pearson has recognised that the most serious accidents are caused by persons being knocked down by cars, and supports this statement by the following figures:—"From 1901, 188 people were killed by trams, cabs, horses and vans, while 9,179 were injured in the same, a total casualty list of 9,383," and he follows up this invention of a new system of arithmetic with a life-guard by which "the person is tripped up by the heels, and its legs knocked from under it, by the projecting tray, which is soft, and falls against the cushion or 'concussion breaker' formed by the net in front of the end of the car, and then drops down on to the tray, and is carried forward unhurt until the car stops." For such a comfortable ride as this we think "it" ought to pay a fare. It may be found necessary to issue books of instructions to intending passengers, but, when properly used, we believe that a considerable amount of revenue may be earned with this "humane guard."

Another of these truly immense inventions is the "obstacle brake," which is described in the inventor's best style, as follows:—"The frictional surface presented by them to the rails is 1,000 times more than the wheels present with slipper-brakes; and 10 times more than magnetic; and, in addition, also present a large surface to the track on each side of the rails, rendering it utterly impossible for the wheels to skid!!!!" (Three of these! are by the inventor, and we have added one in case the full significance of the sentence might be overlooked.) "It will, therefore, be obvious that cars running at any speed can be brought to a dead stand in less than half the distance than they can with any other brakes. They can also be arrested and the speed reduced automatically when running above the regulation speed. The weight is not taken off the wheels, and there is less probability of its being derailed, and, although the stopping will be more abrupt, it must not be overlooked that cars are built to sustain shocks when in collision, and as the difference between the damage done by the latter compared with being derailed will be insignificant, as it will not be wrecked, and the passengers seriously injured or killed, and all the driver has to do before dropping the brakes is to call out to them to sit tight."

Readers may draw their own conclusions from that magnificent sentence. We have felt for long the need of some assurance that any car on which we ride shall be provided with a dependable emergency brake, although we never hoped, lacking the imagination, for one so powerful that the effect of stopping would be greater than a collision. We can never be sufficiently grateful to Mr. Pearson for this culminating invention, and we trust that the B.O.T. will not restrict the use of this brake to tramcars.

Passing over a "Trolley Arrester," which, in Mr. Pearson's picturesque language, will prevent disorganisations of the overhead equipment by the Fiendish Flying Trolley, we arrive at those inventions which fully justify the assumption of the title "electrical engineer," for we are told that a very large saving "can be effected by collecting the waste current from motors on the axle and returning it, and thus prevent its leakage through the rails and electrolysing."

Is not that a crowning triumph? To do away with the necessity of bonding the rails, and to have no return circuit whatever, if we understand the inventor correctly? We are convinced that all this bonding business has been simply assisting the leakage of current, which we ought long ago to have assisted back to the motors instead of helping it away from them. How stupid we have been!

Our conviction is strengthened by reading: "The overhead equipment of new tramways and extensions can also be constructed at half the cost by dispensing entirely with costly columns or posts, span-wires and 'way-leaves,' and without 'boosting-cables' and 'bonding,' and there will be no disorganisation of the overhead equipment, interruptions of traffic, and loss of revenue through that cause, and disabled cars by being 'dead-shorted.'"

We believe that pamphlets containing all the above information, and much more of vital interest to the intelligent manager or engineer, have been sent to every tramway in the kingdom, and we may anticipate enormous developments in the near future.

ALTERNATING CURRENT MOTORS FOR VARIABLE SPEED.

Before the June meeting of the American Society of Mechanical Engineers a paper on the above subject was read by Mr. W. I. Slichter.

The author does not claim that the alternating current motor can compete with the continuous where continual variations of speed are required, but he wishes to show that variable speed is not impossible with A.C. motors. He points out that the speed of an A.C. motor may be varied in the following ways:—

1. By varying the pressure applied to a motor having a suitable resistance in the secondary.
2. By varying the resistance in the secondary.
3. By changing the connections of the primary in a manner to change the number of poles.
4. By varying the frequency of the applied voltage.

The characteristics of an induction motor are similar to those of a continuous-current shunt motor—viz., at a constant impressed voltage (and frequency) the speed will remain practically constant through a wide range of load. The speed gradually falls as the load increases until a critical point is reached, generally 15 to 20 per cent. below

the normal, beyond which the motor is pulled up. Keeping the load the same and reducing the impressed voltage has the same effect.

Pressure Control.—A suitable "compensator" reduces the voltage to the desired value. The power lost is about 5 per cent. of the amount transformed. The rotor should have a high resistance, viz, such that would give a full-load speed about 10 per cent. less than in a normal motor. As the load is increased, the speed will fall to about 30 per cent. of its full value without the motor being pulled up. The efficiency of such a motor is very low, thus for one of 50 H.P., the efficiencies per cent. would be: full speed, 81; $\frac{3}{4}$ speed, 59; $\frac{1}{2}$ speed, 37; and $\frac{1}{4}$ speed, 17.

Rheostat Control.—In this method the rotor must have slip rings. A variable resistance is connected in series with each ring, and the drop in speed for any given torque is practically proportional to the resistance of the rotor circuit. The efficiencies of 50-H.P. motors are respectively 86, 65, 43 and 22, at the four speeds full, $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{1}{4}$.

In this case the losses are in the resistance, not in the motor, which may, therefore, be of a smaller size than in the previous arrangement.

Changeable Poles.—By using a pitch of winding which is commensurable with two numbers of poles, a motor may operate with, say, four or eight poles, six or 12, &c., by a slight change of connections. In such an arrangement the powers and efficiencies would be—full speed, 50 H.P., 86 per cent. efficiency; half speed, 25 H.P., 74 per cent. efficiency.

Variable Frequency.—The speed of a motor will vary directly with the frequency, and we have at full speed 50 H.P. at 88 per cent. efficiency, and at half speed 25 H.P. at 87 per cent. efficiency.

For this purpose generators have been built having two stationary armatures in the same frame, with two revolving fields having different numbers of poles on the same shaft.

Some installations have several generators of different frequencies, and circuits are carried round the shops from each, to which the motors can be connected.

Summary.—The changeable pole and variable frequency methods are the most efficient, but do not admit of a wide range of speed. The rheostatic method is the simplest and easiest of control, and is more efficient than the pressure method. The advantage of the latter is that the motors may be absolutely enclosed, but the large starting currents are objectionable. With the changeable pole, or variable-frequency method, the set speed is fairly constant for any load, which is not the case with either pressure or rheostatic control.

REVIEWS.

Steam and the Steam Engine. By A. JAMIESON, M.Inst.C.E. London: C. Griffin & Co., Ltd., 1902. Price 3s. 6d.

This is the ninth edition of Prof. Jamieson's well-known elementary manual; it has been brought up to date by the addition of appendices dealing with thermo-electric pyrometers, the latest type of indicator, the modern developments of the steam turbine, and examples of recent work in steam engineering. The book is avowedly intended for apprentice engineers and elementary students, in connection with the City and Guilds Institute's technological examinations, and therefore an enormous number of examination questions have been included at the ends of the Lectures into which the book is divided, and in an appendix.

Having regard to the lamentable state of mathematical training in elementary schools, the author commences with three lectures on mensuration; then follow thermometry, the laws of heat, the properties of steam and its behaviour in the steam engine cylinder. The rest of the book—about one half—consists mainly of the detailed descriptions of the parts of engines and boilers, with especial reference to marine and locomotive engine practice.

There is a slight error in the description of squared paper on p. 12, the length of side of each square being given as ·1 of a square inch. The statement on p. 16 that logarithm books are not usually permitted in examinations is already, at least in part, inaccurate. It is somewhat surprising to notice that after eight editions the word "frustum" is still repeatedly mis-spelt "frustrum." The awkward conversion from Fahrenheit to Centigrade scales can be simplified to an easy process in mental arithmetic in the following manner:—C. to F.—Multiply by 2, subtract one-tenth from the product, and add 32. Thus, 15° C.=30−3+32=59° F. F. to C.—Subtract 32 and divide by 2, add $\frac{1}{10}+\frac{1}{100}+\frac{1}{1000}$, &c. Thus, 60° F.=14+1·4+·14+·014, &c.=15·5° C.

The simple short cuts depend, of course, upon the fact that 9/5=1·8=2−·2, and 5/9=·5=·5+·05+·005+ &c.

The experiment of Tyndall described on p. 40—focussing a beam of sunlight upon a point in the interior of a block of ice—is, perhaps, not quite so apt as it might at first appear as an example of radiation; there is no reason, except the imperfection of the ice as a transparent material, why the ice should melt at the focus of the pencil of rays, as the radiant heat ought not to become sensible there rather than anywhere else, unless there is a heat-absorbing construction at that point. We regret to say that the author has not corrected his value of the mechanical equivalent of heat to correspond with the accepted value. The distinction between internal and external work done in the evaporation of water is clearly brought out by the author in a lecture specially devoted to this subject. It is not always fully understood that part of the so-called "latent" heat of steam is really turned into useful work in the very act of evaporation. The statement that superheated steam is not much used, on account of its destructive effect on packing and on the surfaces of the slide valve and cylinder, is somewhat behind the times; superheated steam is rapidly becoming commonplace, and the difficulties formerly met with have been overcome. The "tips" given on p. 121 for the benefit of examinees lay the author open to the charge of having produced a cram-book, though the practical information with which the book is packed renders the stigma undeserved. Without doubt the work is admirably adapted to the needs of elementary students, and merits high praise.

Elementary Applied Mechanics. By A. JAMIESON, M.I.C.E. Fifth edition. London: Chas. Griffin & Co., Ltd. 1902. Price 3s. 6d.

With the new edition of this popular manual are incorporated a very large number of test questions, most of which are obtained from the Science and Art examinations of the past 12 years. A new Appendix is devoted to limit gauges and micrometers, which are now so universally employed in engineering works. The book itself is written for students, forming a companion work to the author's well-known manuals on Steam and Electricity. It is of an essentially practical character, the gravitational units of force and work being employed throughout, and the examples chosen being largely drawn from the workshop, with admirably clear illustrations. The application to actual machines of the various principles and mechanical devices explained and described is abundantly demonstrated, thus giving a living reality to the dry bones of theory which cannot fail to interest the student and sharpen his faculties of observation. The work deserves high commendation both as a class-book and for private study.

Telephone Lines and Methods of Constructing Them Overhead and Underground. By WALTER C. OWEN. London: Whittaker & Co.

There is not much in common between telephone lines and cookery, yet one is inevitably reminded of Mrs. Glasse and jugged hare by the opening paragraph of Mr. Owen's book: "An important preliminary to the erection of an overhead line is that of obtaining the necessary wayleaves." Though we believe George Augustus Sala somewhere said that the quotation was a mistaken one, still there is a very general idea that Mrs. Glasse's instructions were, "First catch your hare," and so Mr. Owen says, "First get your wayleaves," otherwise "stoppage of work will not infrequently result." The work is designed to impart

"a general knowledge of the methods employed in various countries of constructing both underground and aerial telephone line circuits." Its principal value lies in the practical descriptions which the author gives from his own experience, which will be found useful by many who are engaged in line construction. Where Mr. Owen gets beyond his own experience he is less reliable, as, for example, in the indication on p. 159 that a common return wire is frequently adopted as a means of overcoming inductive effects, and to save the cost of a separate metallic circuit for each subscriber. The description of this method naturally finds a place in such a work, but it should not be regarded as one for adoption in any "exchange system."

Design of Dynamos. By S. P. Thompson, F.R.S. London: E. & F. N. Spon. 1903. Price 12s. net.

This is a short work intended primarily for the author's own students. It is confined to continuous-current generators, and is not intended to supersede the author's more complete work on dynamo-electric machinery, a seventh edition of which will shortly appear.

It has been a custom with authors of works of this class to claim that, by the aid of their particular text-book, any person, even if possessing no previous knowledge whatever of the subject, could easily design satisfactory dynamos.

We are glad to note that Prof. Thompson in his introductory remarks does not make such a claim. He points out that although the scientific principles of dynamo design can be taught with precision, the satisfactory design and construction of dynamo machinery require practical experience and judgment, just as much as any other branch of engineering work.

In the general arrangement of the book the author takes us through magnetic and copper calculations, remarks on insulating materials and armature windings, predetermination of efficiencies, and the design of dynamos on the principles laid down in the preceding chapters, and concludes with a series of examples of up-to-date dynamos by leading makers.

There is also an appendix containing wire tables and a sample schedule for entering up particulars of dynamo calculations.

In the chapter on magnetic calculations we notice that the curves are given in the practical units of inches and pounds, instead of being given in units which require to be translated before they can be compared with one's own results. This little detail of itself is sufficient to commend the book to the practical designer.

Of the curves we think the most valuable are those relating to hysteresis, eddy currents, and the ratio between the apparent and true density in armature teeth.

In dealing with copper calculations, the author gives a curve, showing the variations of value of the temperature coefficient for different types of construction of armature and different peripheral speeds. The author mentions that the amount of the draught from the armature causes a similar variation in the value of the temperature coefficient of the magnet windings, and it would have been an advantage if he had given us a curve of this also.

Equalising rings are dealt with, and an illustration given of an armature fitted with them; the rings, in this instance, are placed at the end of the armature remote from the commutator. On the subject of sparking, we notice the author adheres to the idea of a ratio between the forward and cross ampere-turns, in preference to the more usual method of dealing with the voltage in the coil during its period of short circuit.

The examples given of dynamo design include machines by the late Prof. Short, Mr. Hobart, Messrs. Scott and Mountain, Messrs. Kolben & Co., &c.

Mechanical Refrigeration. By Hal Williams. London and New York: Whittaker & Co. 1903.

The subject of mechanical refrigeration is one in which there has never been much literature. The importance of refrigeration to this country is great. The earlier machines worked with air as a medium, but these are less effective than the machines which work with sulphurous acid, ammonia, or carbonic acid. The theory of refrigeration occupies the first part of the book, and the thermodynamics of the subject are fully dealt with. Chapter III. is historical. Kirk's machine appeared in 1861, and did good work. In 1868 Postle invented a cold-air machine. Coleman and Bell built a cold-air machine in 1877, which was used in the trans-Atlantic trade. A machine of this type was fitted on the *Strathleven* in 1879, a steamship which brought home the first cargo of frozen meat from Australia. The *Dunedin* brought home 5,000 sheep in 1881.

The ammonia machine was made by Linde, in 1873, and very many agents have been employed, notably methyl chloride and analogous substances, and even acetylene, but practically ammonia and CO_2 alone hold the field to-day. Ammonia at 0° F. has a pressure of 30 lbs. per sq. in., a latent heat of 555·5 B.Th.U., measures 9·1 cb. ft. per pound, and has a specific heat of 1·02. It liquefies at −30° F. under 1 atmosphere of pressure, and is the only volatile alkali known to science. Nature might have selected a pleasanter exception to the rule of non-volatility. To rescue a person in a room full of ammonia vapour, the rescuer may safely enter if he covers his mouth and nostrils with a wet sponge or waste, which will absorb the ammonia for a time. Vinegar, weak acetic acid, or beer should be administered to the sufferer, as a restorative.

Carbonic acid or anhydride is not unpleasant, in the same sense as ammonia. It is simply neutral, and does not support life. It is thus safer to employ than ammonia. Its manufacture and compression are described. It may be sold at 1,800 lbs. pressure, ammonia being restricted to the more moderate pressure of 1,000 lbs.

The various types of machine are described in some detail, with great impartiality. In the chapter on auxiliary plant, the author makes some strong remarks on the consulting engineer, who, not content to act as a consultant and advise us as to which appears the best machine to buy, must himself design that in which he cannot be an expert.

A chapter is given to insulation, for which hair-felt again heads the list, kapok fibre coming next. Another chapter deals with brines, others with water distillation, the faults in ice, such as the red core due to rust, ice making, and the construction of ice stores.

Finally, cold storage is treated of, with practical remarks on the special treatment of all sorts of produce.

Electrical power transmission should be employed in freezing houses, but electric driving is not recommended to drive compressors—the worst work a motor can be set to do, probably because of the varying torque, which does not exist in those compressors which have several cylinders set radially to one crank pin.

Taken all round, this is a most excellent treatise on the subject.

CORRESPONDENCE.

Free Trade Zones in Italy.

There is a movement now in progress in Italy which has an important bearing upon the controversy raised by Mr. Chamberlain. At a meeting of the Union of Italian Chambers of Commerce, held in Rome on June 28th and 29th, resolutions were passed demanding the immediate establishment of Free Trade zones in the chief maritime cities.

The following are the principal regulations proposed:—

1. All goods may freely enter these zones without paying any customs duty, and may equally be sent out free of duty if destined for export.

2. The manufacturing and other handling of goods in these zones will be exempt from all customs formalities and duties.

3. The necessary buildings of every kind will be allowed within the zones.

4. Food and drink consumed within the zones will pay the proper taxes.

5. These free zones are to be established solely to favour exportation, and only in those cases in which no harm can

be done to the existing home industries. Any goods sent from these zones into the interior of the country will be subject to customs duties under the maximum tariff, augmented by a surtax.

The above summary clearly explains the scheme. The Italians have discovered that duties upon imports make it extremely difficult to do an export trade. The Italian Chambers of Commerce, therefore, propose that factories and workshops shall be established at the sea ports in zones free from all customs duties. There is already one such zone on a small scale at Genoa. The free area is surrounded with lofty iron railings, and armed policemen are constantly on the watch to prevent smuggling. This will serve as the type for the more extensive scheme now proposed.

The scheme is chiefly of interest to Englishmen as showing how Protection breaks down in practice by its own weight, and how Protectionists are driven to all kinds of subterfuges to escape the logical consequences of a false theory. This Free Zone plan will obviously be injurious to many Italian manufacturers in the interior, for they will be unable to continue—in face of the competition of the Free Zones—any export trade that they may have already developed. It is true that they will be confirmed in the privilege of charging their own countrymen an excessive price for manufactured goods, which means that one Italian manufacturer in the interior will be producing at high cost for Italian consumption, and another Italian manufacturer on the coast will be producing at low cost for foreign consumption. In England, happily, we are saved from the iron railings and the armed policemen, and the high internal prices, because with the aid of Cobden and Peel we have succeeded in making our whole island virtually one free port.

Harold Cox,
Secretary to the Cobden Club.

Gray's Inn.

Regulation of Traffic at Tramway Termini.

The efficient regulation of traffic at busy points on tramways is receiving considerable attention in all our cities, and I shall be glad if you can allow space in your "Correspondence" column for me to ask what are the most satisfactory solutions of the problem?

Where no system of marshalling the people is enforced, the weak and meek can stand waiting until the pressure is relieved, while the pugnacious force their way in with undue vigour.

One only need observe crushing for a few moments to see how much slower the progress is than if everyone goes in turn in an orderly manner.

Manchester tried the queue with which we are familiar at theatre entrances. The County Council started with a similar system.

I consider that policemen should be stationed at every busy terminus in sufficient numbers to compel the taking of places in the order of arrival at the starting place.

Where large numbers enter trams, special provision should be made. We have in our 'buses at every busy corner in London an object lesson, which, if applied to the tramways, would enormously reduce the risk to those entering the cars by keeping them out of the roadway, and at the same time would facilitate the movement of horse-drawn vehicles and automobiles. Passengers always wait on the footpath for an omnibus, which draws alongside of the curb, and, after loading, is pulled out into the centre of the roadway.

The accompanying sketch shows this idea applied to one of our busiest tramway termini.

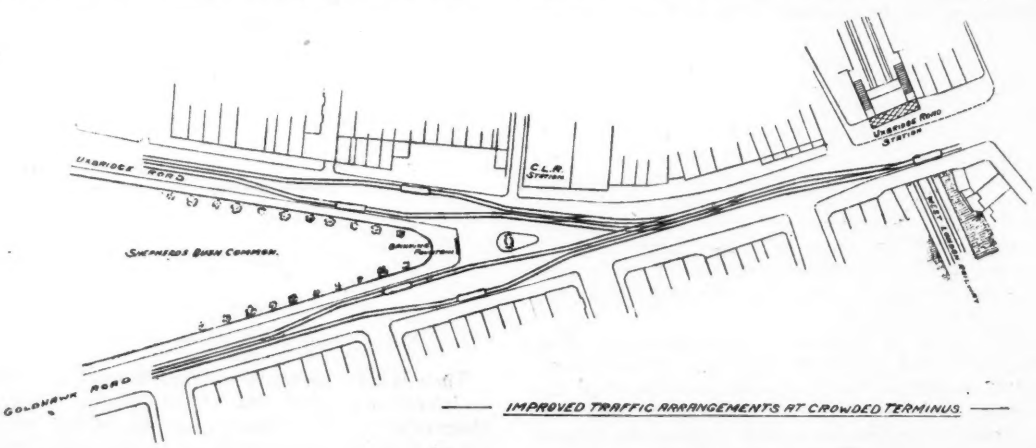
It shows cars discharging and picking up passengers from the footpath, and in most cases shown, it is possible to do this without inconvenience to frontagers.

The essentials appear to be (1) to avoid fixing rails close to the curb near side streets from which the view is obscured by buildings; (2) to utilise footpaths adjoining open spaces, or on or under bridges for this purpose as far as practicable. It is clearly necessary to have Parliamentary powers for such an innovation, but the Board of Trade would, I feel sure, facilitate any effort to secure such an improvement.

Have any of your readers tried this or a better plan?

T. St. M. E.

London, *July 24th*, 1903.



IMPROVED TRAFFIC ARRANGEMENTS AT CROWDED TERMINUS.

International Fire-Prevention Congress.

With regard to the report that you give of the International Fire-Prevention Congress, may I be allowed to make the following remarks relating to the two addresses to which you allude:—

First, with regard to Mr. Alex. Siemens's paper, the system of fire alarms recommended by Mr. Siemens is gradually dying out in practice. No fresh installations of them are being made, and those already in use are being suppressed, and with reason. Their utility is very questionable. Experience has shown that they are the last thing thought of in times of emergency. One often sees a crowd assembled in front of one of these alarms without anyone thinking of using it; the excitement is often so great, that even those whose property is involved do not think of it. Moreover, these alarms necessarily occasion losses of time which may be considerable in the case of unoccupied houses, or fires that occur late at night. The use of the telephone is universally admitted to be unsuited to this purpose, as it affords no indication of the time at which the alarm was given. The telegraph is also unsuitable, as it necessitates special operators; thus there only remains automatic transmission by means of a toothed wheel, as Mr. Siemens suggests. Nevertheless, in order to be reliable, the circuit should be entirely metallic and underground. In that case the cost would be enormous, especially as the alarm stations would have to be very numerous.

A better solution of the problem is that suggested by M. Mollo, chief of the Naples Fire Brigade, and sent by him to me. In his system, he utilises automatic wireless telegraphy. The transmission boxes are fitted with various buttons, which indicate the locality, the nature and the importance of the fire.

As to Mr. Oatway's paper, I was happy to see that my apparatus, described on page 99 of the same number of the ELECTRICAL REVIEW, fulfils completely the conditions that seem to have been voted unanimously at the meeting. Perhaps it is the only one that does fulfil them in practice. In fact, the first condition requires that every house and

even every market-place should be provided with a transmitter. Can we imagine a town like London provided with such an extensive and such a complicated system? We might, it is true, use the telephone service to a certain extent, but everyone is not connected with the telephone, and we should lose time in establishing communication with the central office; the system is only too prone to get out of order, and there is no means of utilising the system proposed by Mr. Siemens for finding out whether there is any current or not (circuit constantly closed).

The first condition laid down by Mr. Oatway is, that the apparatus shall be able to work under any atmospheric conditions, an impossibility with wires which are broken by wind and snow, and fused by lightning or by the fire itself, as in the case of the warehouse fire at Antwerp, the fire at the Lacroix paper factory, &c.

Let us consider, on the other hand, my wireless automatic alarm. It has advantages over all the combinations that can be made with wires either for transmitting or receiving, and it avoids all the disadvantages attached to wires. In fact, as the distance of transmission is short, and can be still further diminished by the use of repeaters placed in each district, we could construct apparatus that would be sufficiently strong and well protected to be sheltered from all outside disturbances. Indeed, the connections to earth—a fertile source of disturbance—might be replaced by condensers, and the antennæ used could be very short. Moreover, the smallness of the transmitters would enable them to be protected from fire by means of a fireproof case. Nothing would be more simple, with this apparatus, than to make observations. I have tested mine several times a day, merely by holding a candle near the thermometer.

At the fire station only a single receiver is required, so that matters are simplified greatly.

Moreover, this apparatus would prevent firemen from going out uselessly, a desideratum that cannot be obtained with ordinary telegraphy. The occupants of the house being communicated with by means of a local signal can stop the transmission, if they think that the intervention of the fire brigade is not required. If the firemen have already started, they are notified by the cessation of the signals at the receiver with which their engines are provided. This receiver is similar to those used on the Marconi war cars.

The firemen can also receive notice when *en route* of any other fire that may have broken out, and proceed in that direction when they find that they are no longer required at the first one.

E. Guarini.

Protection or Fair Trade?

(*Concluded from page* 176.)

The reply you make to the disadvantages put forward against Free Trade is usually called the "consumer argument." Other Free Trade writers have laid down this argument in the same sense; they have expressed it in different terms, such as "cheapness to the consumer," "Protection legislates for the few to the detriment of the many," "Look after the consumer and the producer will look after himself."

The primary fallacy of these theories is that Free Trade is supposed to possess some virtue in producing cheapness. No doubt this idea is engendered in the course of time owing to the underselling of our native producers by foreigners, so that the idea must have come about that all that comes from abroad is cheap, or sold under cost, or even, in some minds, that we do not pay for it at all! This last notion is aptly (and innocently) illustrated by the clever caricaturist, Mr. F. C. Gould, in the *Westminster Gazette*. A flock of quails, coming like manna from the skies, and Mr. Chamberlain as Moses; "Go away, you quails," says Mr. Chamberlain, "you interfere with our native chickens." I agree, of course, that if foreigners were to give us their wheat or wool or motors for nothing, it would be foolish of us not to accept them; but I assure my Free Trade friends that they do not give them for naught: on the contrary, they require and get full value in malt or wool, and, beyond that, a good profit into the bargain.

The truth is, that this apparent cheapness is not real; it does not exist. Cheapness is merely relative. In comparison with English goods, foreign goods may appear cheap, but they are not truly cheap; the home-made article is dear. The right policy should not be to encourage the foreign producer with our orders, but to help the home producer to make as cheaply as the man abroad; and that he is able to do this if you give him the chance, I have demonstrated in my last letter.

You illustrate your argument by the story of the printer who required an electric motor. The lowest English price was £170. The lowest foreign price £100. Mr. Wilson avers that the nation is the loser, because the English motor maker did not get the £170; you say the printer was right, and being £70 better off, could spend this sum more profitably in the country. If you consider the two individuals solely your contention may be right, but if you consider that both belong to the same nation or family, you will find that from a national point of view the country cannot possibly have gained. What B has gained, A has lost; but you cannot get over this point—£100 has left the country, money which would have remained here in wages or profits, with the small exception of the cost of raw material, such as, in the case of the motor—raw copper, cotton and mica.

Theories.—The early Free Traders must have seen this point, *i.e.*, of encouraging the foreign producer, and the consequent threatened loss of capital; and the weakness of the "consumer argument" must have been revealed to them. What did they do? They produced a couple of theories to disprove the common-sense view. These are:—(1) If a man or a nation cannot make a thing as well as another, he will make something for which he is better fitted; (2) Goods imported are paid for by goods and services exported.

If these two theories are right, your consumer theory is correct—but are they? These theories were given us by a former generation of thinkers, and expressed by such men as Adam Smith, Ricardo, Mill, &c. The present generation has accepted them, for if they disbelieved them they must also disbelieve the whole of Free Trade. But they are fallacious and mischievous and without common sense, as I will show. To my mind the question now occurs, How could otherwise sane men bring these theories forward as if they were laws of nature? The answer is that they fitted into the times when they were coined. A century ago—even 50 years ago—England was the factory and workshop of the world. The rest of the nations, with small exceptions, were agricultural. New Continents were entering the horizon of commerce, but they were purely agricultural. Our Free Trade thinkers considered this providential. "You," they called out, "are best fitted to grow wheat and cotton and potatoes; we are best fitted to weave your cotton and to fashion iron for you."

This worked well then, but in the course of time other nations would not play the game; and to-day there is no such dividing line between agriculture and manufacture. That law, which appeared true 50 years ago, is to-day a hollow mockery. Yet you Free Traders cling to it, and in pursuance you practically say just the contrary to what Adam Smith thought was the case; you say an Englishman in Spitalfields is not fitted to weave and dye silks as well as the German of Crefeld; the Englishman in Birmingham is not fitted to make electric motors as well as the Americans of Pittsburg, and so on in all those trades which we have permitted to leave our shores.

All this may seem strange to you, but your story of the printer and his motor comes to nothing short of this. Soil and climate may fit one country to produce something better than another, but when we come to modern manufacturers this theory is absurd and must ultimately lead to disaster.

The second theory worked out by our Free Traders, and which we can see repeated weekly in the *Spectator* and daily in numbers of newspapers, says:—"We pay for our imports by our exports in goods and services (for shipping, &c.), and as foreign nations make best what we cannot make, and we make what they cannot make, it follows that the exchange must leave a profit."

Do actual facts bear out this theory? We buy from abroad our food-stuffs in order to live, because we have reduced our own agriculture. We buy raw material and manufactures because we have at present no choice. We do not regulate our imports in the slightest. We open our mouths, shut our eyes, and wait to see what the foreigners will send us. If you go to a horse-dealer and he knows that

you will only buy a bargain, he will make a cheap price for you. If he knows that you must have the horse, he makes you pay through the nose. Say what you may, theorise as you like, we are at present paying through the nose for our imports.

Now, how about our exports? Here again it is not we, but the foreigner who has the choice. He will buy from us only what he does not want to make himself. Adam Smith and his theory do not count with him. He puts a tariff on what he likes, and not on what we wish him to, and he buys from us only those goods which will pay us the lowest wages and the lowest profits. These are hard facts, and common-sense ones. Can I credit that you will not accept them?

Since this theory was given, something further has occurred. The balance of trade (*i.e.*, the difference between our visible imports and exports) has enormously increased from £60,000,000 in 1870 to £180,000,000 in 1902. It is, of course, obvious to the Free Trader that services for shipping could not account for the difference. "Never mind," he says, "we will include the interest on foreign investments." He does not see that this alone upsets his theory of a profitable exchange. By using interest as payment for part of our imports no wages are paid; neither are there taxes, expenses or profits. This admission on the part of the Free Trader also proves something further. A nation's accounts are not different to those of an individual. Suppose a man has a business which brings him in £1,000 a year, and beyond that he has investments representing savings, the interest on which is £500 a year; if this man lives on £1,500 a year he puts nothing by, and if he is careless besides, he will have to live upon capital, unless he reduces his living expenses. Now, that is the position to which our careless way of believing that we can import, regardless of common sense, is leading us.

"I have heard this cry for 30 years," says the Free Trader, "and if true, the country would have gone to the dogs long ago," but 30 years is a short time, and there are some retarding forces. Let us, however, look to the future, and cast aside the theory that our imports are paid for by exports, and that this exchange leaves us a profit.

The Consumer Theory in Practice.—I have shown to all those who are willing to see, that this argument is fallacious in theory; its application in practice also bears this out. In order to justify it, we must show that we can actually and permanently obtain commodities from abroad which under no circumstances can be produced as well or as cheaply in our own country.

I hardly think that it is necessary for me to say much about this; everyone can investigate it in his own trade, but it is my firm conviction that we do not get our butter, our eggs, our meat, our raw material, or our manufactures cheaply. We reduce home competition and rely on the foreign producer. He gives us temporary cheapness, but only until he has accomplished his object—namely, to kill home competition. He is then master of the situation, and squeezes us, and he will continue to squeeze us the more helpless we become.

A well regulated list of duties, with preference within the Empire, will bring us real cheapness, but not this *laissez faire* policy.

Take our trade, the electrical industry, and investigate thoroughly item for item. We have imported millions of pounds' worth, and we allow our colonies to be over-run with German and American electrical goods. I say with deliberation that there is not a single article comprising the long list of electrical goods imported from abroad that we could not make as cheaply and as well had we but the same chances. It is well-known that the equipment of the so-called "Twopenny tube" was not cheap; that the American plant left the makers a good profit, and that we could have produced it at a lower cost had we had Protection. We should then have had larger factories, and could have coped with this big work both at home and in the colonies, and I have competent authority for stating that the purchasers would have had to pay less; but as there was no English competition to overcome so there was no cheapness.

It is also a fact that American and Swedish telephones have been sold more cheaply in Protectionist Germany than here. I have seen German lamps sold in Madrid to the consumer at a lower figure than in London. All that our consumers get is a temporary cheapness of the "catch-penny" kind. A shopkeeper puts an article in his window at a low figure to get into the trade and to ruin his neighbour, but he sells ten other articles dearly under the cloak of being a "cheap shop."

Individuals v. the Nation.—Reverting to the question of the printer. He may have got a cheap bargain, but if duty had been paid for that motor it would have relieved direct taxation. The printer would have had to pay less rent, less rates, less income-tax, and so would his workmen. Direct taxation has increased to an alarming extent since Free Trade became operative.

The Future.—Your consumer argument must not only logically, but actually, come to this—we shall all be consumers. How, then, are we to pay for our food which comes from abroad? The taxes required to keep up the country will fall on the consumers, and the tendency is already that way. We now pay £9,000,000 a year to aid the agricultural producer who has had to be sacrificed to the so-called "cheap loaf."

Skill and Invention.—And if your solicitude for the purchaser is to prevail, and the producer is to shift for himself, how will the skill of our workmen and the inventive genius of our people fare? Are they to be maintained by "technical universities" which will be paid for by the consumers? No. Your consumer argument sounds plausible, and has taken many in, but it is dangerous and wrong. He deserves well of his country who makes two blades of grass grow where only one grew before: that is the only true political economy.

In conclusion, I maintain that no one who works is a consumer in an economical sense. He must produce first before he can consume, or he must be dependent upon the success of the consumer, as, for instance, the policeman or the soldier. Pure consumers are but the idle who have inherited wealth and live upon it; and even they are better off if consols are high, and if the country is prosperous. But why should we legislate for the Drones, and leave the Working Bees "free"—free at the mercy of our rivals?

If there were any truth or reason in the belief that Free Trade gives cheapness to the consumer, it would still be wrong to try and attain it at the expense of the producer; but as it is fallacious in theory and non-existent in fact, and as it is the only seeming argument in favour of our existing policy, then I say that policy has not a leg to stand upon.

G. Byng.

Development of the Current Interrupter.

May I be allowed to confirm Mr. Wright's statement that the Wehnelt break *can* be used on an alternating circuit?

I have had occasion to employ the electrolytic break in every modification, and on coils originating from practically every maker, both British and foreign, and therefore venture to submit that Mr. Codd's contention that a coil will, under these conditions only, give from 25 to 50 per cent. of the full spark length, must be based upon some defect in his experimental arrangements.

There may be a decrease in the spark length when using a coil with unsuitable self-induction in the primary, but this can be compensated for in a variety of ways.

Coils which are fitted with proper primary windings will give their full spark when run from alternating currents through either a Wehnelt or a Caldwell break, and may, moreover, be made to yield unipolar impulses in the secondary.

The disintegration of the platinum may be greatly diminished by using aluminium instead of the lead plate, and by suitably proportioning the exposed area of the platinum.

A. W. Isenthal.

London, *July 31st*, 1903.

The I.E.E. Building Fund.

With reference to your article in the ELECTRICAL REVIEW for the week ending July 31st, *re* the above, I beg to state that I am not quite of your opinion in this matter.

First, I consider that the Institution *ought* to have a building of its *own*, and *not* shared by some other institution. Secondly, I am given to understand that the property in Tothill Street is *increasing yearly in value*; there-

fore the Institution can in a few years' time (if found desirable) sell it at a considerable profit. Personally, I should like to see the Institution building in some prominent place, such as a main thoroughfare or square, but if this is not possible, owing to the scarcity of sites and the enormous cost of such sites, we must be content with what we can secure. *If*, as I have said before, the property in Tothill Street *is increasing in value* every year, the members of the Institution need have no fear.

D. R. Broadbent.

London, S.W., *July 31st*, 1903.

It will be interesting to hear how the Council of the Institution of Electrical Engineers will describe the meeting which took place last Friday at 92, Victoria Street. That the Council should see fit to hold a meeting of such importance a day or so before the summer holidays seems, to say the least of it, extraordinary. Out of some 3,500 Members, Associate Members, and Associates, there were, as far as one could judge, about 30 people present, of whom at least a dozen were Members of Council.

With this *truly* representative gathering, the Council obtained the sanction of the Institution to purchase, at the sum of £16,500, certain property in Tothill Street. From what one may gather, it would seem that almost all, if not quite all, the available funds of the Institution of Electrical Engineers are to be used for the purchase of this site, upon which, in the *distant* future, a permanent home is to be built.

The whole affair has come as such a surprise that one is somewhat nonplussed. Why have not those who belong to the Institution been consulted? Surely they have a right to a say in the matter, and should have been properly circularised, and thus enabled to put on record their opinion of the scheme.

It is curious how very many opinions seem to be in favour of quite a different scheme.

As pointed out by the ELECTRICAL REVIEW, the Institution of Civil Engineers is likely to be absorbed by the Government offices sooner or later, and therefore this might be a not unfavourable opportunity for approaching the Institution of Civil Engineers as well as other scientific bodies with a view to a combined scheme. A central position might be obtained, and a large and commodious building be erected at much less expense to each individual Institution than would be incurred in the case of a separate building, as proposed by the Council of the Institution of Electrical Engineers. It is to be hoped that the hole-in-the-corner decision snatched from the few members who were present last Friday will not be taken as final, or as voicing the opinion of the members at large, and that every Member, Associate Member and Associate will have an opportunity, at some later date, of signifying his approval or otherwise. It is a consolation to think that the investment is no doubt a sound one, as the value of the property will increase rather than decrease as time goes on. This certainly seems the only saving clause in the whole affair.

A.M.I.E.E.

[We refer to this matter in our leading columns.—EDS. ELEC. REV.]

Hot-Wire Arc Lamps.

My attention has been called to an article in your valued paper on hot-wire arc lamps. In this article the writer shows a singular lack of knowledge of modern arc lamp practice. His remarks *re* the dash-pot cannot even apply to inferior and cheap types of lamps made within the last five years. The percentage of failures due to dash-pot sticking taken from the books of one of the best known makers is given at ·1 per cent., while dirty rods, improper trimming and break down of insulation account for ·9 per cent. of the known cases of failure. Personally, I know of several installations of over 100 arcs running continuously for a number of years without any dash-pot troubles of any description.

The assertion that it is impossible to eliminate dust from the dash-pots makes one wonder whether this is the year 1903 or 1890, also the statement that hot-wire lamps are likely to cause a reaction in favour of arc lighting by old users and others savours of the American catalogue. I should very much like to know the percentage of old users with whom arc lamps of decent make have come into disfavour. The mere avoidance of parts that have been proved to work satisfactorily for years—namely, the coil and dash-pot—does not in any way suggest that improvements have been substituted. To say that three lamps can be run in series on a 240-volt circuit does not seem in any way remarkable, and leads one to infer that the solenoid lamp cannot be made to run under these conditions, and where the mysterious 50 per cent. more light claimed for the hot-wire lamp comes from the writer can only suggest, for I am under the impression that three arcs maintained by means of solenoids would emit the same light as three regulated by hot wires, provided, of course, the carbons, current consumption and voltage across the arcs were similar. Is it that the series coil of solenoid lamps accounts for the 50 per cent. decrease of light to obtain the alleged reserve of force to overcome increasing friction of the dirty dash-pot?

Another point I crave Mr. Tomlinson Lee to enlighten me on is, how he obtains a 72-volt arc with three lamps in series on a 220-volt circuit when the current consumed is 5·5 amperes, and the resistance of the lamp mechanism is distinctly stated as 2 ohms? Surely Ohm's law applies even to a hot-wire arc lamp. Again, how can the best result be obtaining on alternating circuits when you have a lamp mechanism resistance of 2 ohms?

I would like to know what would happen to the three lamps running in series on a 220-volt circuit if the mechanism of one became dirtier than the others. Would it refuse to strike and allow the other two to flare away with long arcs, or has Mr. Foster to use a shunt coil or shunted hot wires?

I should like to remind the writer that it is quite possible to design a solenoid lamp that can be switched over from continuous current to alternating current circuits and *vice versâ*. The reason why this type of lamp is not generally made, is that the solenoid lamp only exists for commercial purposes.

N. D. W.

"G. N.," Sutton.—Your address was omitted from your letter.—EDS.

MUNICIPAL TRADING.

AN important report has been drawn up by the Joint Select Committee of Lords and Commons which was charged with the consideration of this subject. The Committee, recognising the impossibility of adequately dealing with the whole subject in a reasonable time, confined its attention to municipal accounts, and states that ratepayers should be fully informed as to the success or failure of each undertaking, which is sometimes not the case. The question of prescribing a standard form of accounts is recommended for the consideration of the Local Government Departments, and the matter of an official audit has received special attention.

It is under this head, indeed, that the most important recommendations are made; the Committee is of opinion that the existing systems of audit should be abolished, and an official auditor be appointed by each county, borough, or urban district council, subject to the approval of the Local Government Board. The auditor's duties, besides the mere certification of figures, should comprise the supervision of the accounts, including an expression of opinion as to whether "the accounts issued present a true and correct view of the transactions and results of trading," and upon "the necessity of reserve funds, of amounts set aside to meet depreciation and obsolescence of plant in addition to the statutory sinking funds and of the adequacy of such amounts." Moreover, he will be required "to report independently to the Board any case in which an authority declines to carry out any recommendation made by him."

The Committee is of opinion that the investigation should be continued in other branches of the subject of municipal trading.

Time and space compel us to defer our comments to our next issue.

E

LEGAL.

Bank of Liverpool *v.* Milnes & Co.

The matter of the Bank of Liverpool against G. F. Milnes & Co. and the Law Guarantee Trust, came before Mr. Justice Swinfen Eady in the Chancery Division on 31st ult. by way of motion for the appointment of a receiver and manager of the business of G. F. Milnes & Co., electric car builders, of Widnes, Lancashire.

Mr. Micklem, K.C., for the plaintiffs, said the motion stood over last week, the company undertaking to pay the current wages, and suggesting that there was some chance of the property being sold. An affidavit had been made by the other side which had not yet been filed, but he was obliged to press for the order. The Law Guarantee Trust were trustees of two issues of debentures, and the bank held the whole of the issue.

Mr. Eve, K.C., for the defendants, was afraid he was at the mercy of the plaintiffs. They had carried out the undertaking they had given last week, and were prepared to renew it for another week. His view was that the appointment of a receiver at this juncture would lead to the breaking off of negotiations for the sale of the business at a price which was sufficient to pay the whole of the creditors in full, and leave a sum for distribution *pro rata* amongst the shareholders. The debentures were not repayable until 1911, and no default had been made. There was only £500 due to the bank as against £32,000 to other creditors.

Mr. Micklem said plaintiffs had been instructed for two months past that negotiations were going on for the sale of the business, and he could not consent to further delay.

His Lordship said if plaintiffs pressed their claim he could not refuse, and granted the order accordingly.

National Electric Traction Co. *v.* Electric Construction and Maintenance Co., Ltd.

Mr. Justice Swinfen Eady, in the Chancery Division on 30th ult., continued the appointment of a Receiver to the defendant company in this action.

Dixon *v.* Hall & Co.

In the County Buildings, Glasgow, Sheriff Strachan last week issued judgment in an action for breach of contract, raised at the instance of William Dixon & Co., electrical engineers, 59, Bath Street, Glasgow, against Messrs. J. P. Hall & Co., electrical and general engineers, Oldham, for £464.

The pursuers entered into a contract with Messrs. Napier Bros, engineers and shipbuilders, Glasgow, for an electric installation in their works, and in the month of March, 1899, they ordered from the defenders a 60-kw. dynamo to enable them to carry out that contract. The dynamo was to be delivered in six months at the price of £233. In the month of July following, defenders found that owing to an error in their calculations, the dynamo which they had made was not suitable, and could not be used, and they resolved to make a new machine. Until the new machine was ready the defenders sent the defective dynamo to be used as a temporary one at Messrs. Napier's works. The new dynamo was delivered by the defenders in January, 1900, and was fitted up in the works, but on being tried it was also found to be disconform to contract, and defective in many respects. Various efforts were made to put it in a proper condition, and to get it to work, but without success, and after final trials it was still found to be defective, and was ultimately rejected by the pursuers. In January, 1901, the defenders raised an action against the pursuers for payment of the price of the dynamo. This action was defended on the ground that the dynamo was disconform to the contract, and had been properly rejected. A proof was allowed in the action, but before the date fixed for taking the evidence the defenders abandoned the action and paid the pursuers their expenses. The present action had been raised by the pursuers for the loss and damage sustained by them through the failure of the defenders to supply them with a dynamo on terms of the contract. The breach of the contract on the part of the defenders was admitted, and the only question between the parties was the amount of damage which had been sustained by the pursuers.

His Lordship awarded pursuers £183 9s. 4d. with expenses.

THE FIRE EXHIBITION AT EARL'S COURT.

The G.E.C. Exhibit.

The stand of the General Electric Co., Ltd., deserves special mention, as it is devoted almost entirely to the firm's manufactures in connection with electric fire alarms. It is situated in the Queen's Palace, and is easily recognisable.

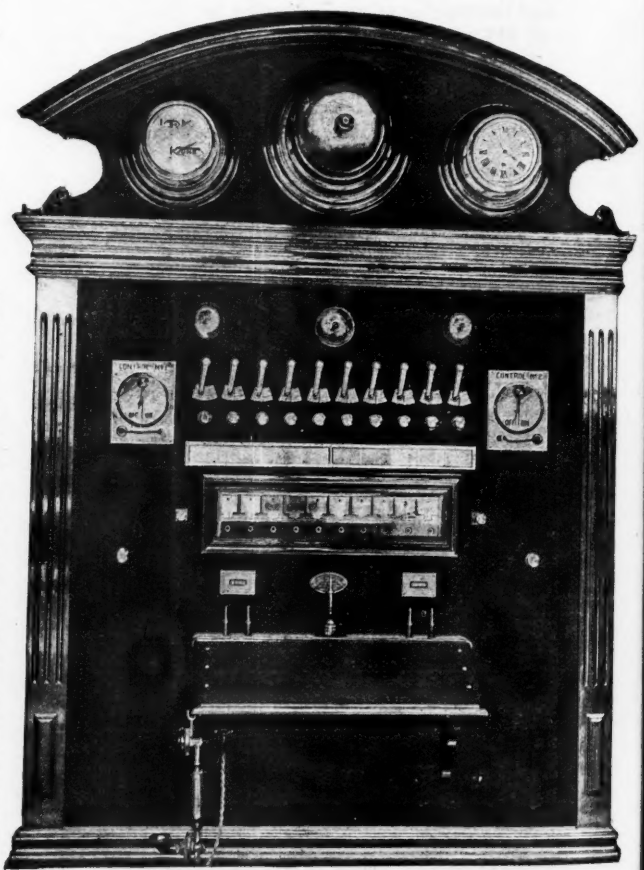
The exhibits comprise all manner of devices for fire alarms. An important show is made of the firm's apparatus for private fire alarm systems, or for use in public buildings, schools, &c., and we may mention in particular the special automatic contacts used by the Metropolitan Asylums Board for all their asylums. This apparatus is arranged with backward and forward contacts, so disposed that the backward contact can be used for an ingenious system of testing the lines, and the forward contact is made automatically when the glass is broken.

We understand that the G.E.C. adapt their private fire alarm apparatus to any requirements; for instance, on large estates they can all be made to ring into the porter's lodge; or, on the other hand, they can be arranged to ring on every floor. A special fire alarm indicator is shown, which can also be arranged for either of the above purposes, so as to show the source of the alarm call, and, therefore, the probable position of the fire. In addition to these apparatus, there is a good display of telephones, bells of various sorts, and we noticed a special polarised bell for ringing up the police on point duty. The most important exhibit is the G.E.C. special system of fire brigade alarms. A large annunciator switchboard is erected in the centre of the stand, and four posts are situated in various parts of the grounds for demonstrating the efficacy of the system in actual practice.

The functions of the posts are to act as fire alarm pulls to be operated by the public in the event of fire, and to serve as street telephones for the use of the Fire Brigade in the execution of their duties.

The Annunciator switchboard is to receive a call from the street posts; to indicate from which post the call is given; to discriminate between genuine and accidental calls such as "earths," &c.; to allow of the lines being tested; and, where required, to serve as a switch for connecting any street post with the police station, turncock or other official on the system.

When the pull in the post is operated the indicator on the switch-



G.E.C. Fire Station Switchboard.

board at once drops, closing the local alarm bell circuit, and the bell in the post at the same time rings. The fireman attendant in the watchroom inserts his answering plug in the spring jack underneath the fallen shutter, and the discriminating buzzer (which is single stroke) at once emits a loud buzzing sound, due to the fact that it is working in series with the vibrating bell in the post. If the alarm were caused by "earth" on the line, the buzzer would not operate, and the Brigade would not be called out unnecessarily.

After calling out the brigade, the attendant withdraws the answering plug, and inserts in its place a plug belonging to the control indicator. This stops the bell ringing in the post, and the control indicator pointer is deflected to the "on" position. The answering plug is now available to receive further calls.

When the post-handle is replaced, the control indicator returns to the "off" position, and the control bell rings continuously until the plug is withdrawn and placed in its normal position. The attendant should now insert his answering plug and listen on the telephone to ascertain if the person replacing the pull wishes to speak to him.

The operation of the post is extremely simple. The pull is replaced by lifting the telephone. If it is required to speak to the fire station, it is only necessary to hold the receiver to the ear and press three or four times on the small push button provided for the purpose.

The company also make another form of post, which is installed at Tottenham, Penge, Finchley, &c., and which we have already noticed in previous issues of this journal. Briefly, it may be said that this post does not contain a telephone, but the firemen carry a pocket telephone with them, which is plugged into sockets inside the post. These posts can be used with the annunciator board already described. This type of post is so used in connection with the G.E.C. system of traction telephones.

A further exhibit is a fireman's call switchboard, built to L.C.C. specification. Of the other exhibits, too numerous to specialise, we must conclude by stating that they seem to be well standardised and of high-class manufacture. We understand that all were made at the company's works at Manchester.

PARLIAMENTARY.

Workmen's Trains.

The Select Committee of the House of Commons, which had been appointed under the chairmanship of Mr. Bonar Law, the Parliamentary secretary to the Board of Trade, to consider the question of workmen's trains, commenced its sittings on 29th ult. The first witness called was Sir Francis Hopwood, the permanent secretary to the Board of Trade. After dealing at length with the legislation which existed before the passing of the Cheap Trains Act of 1883, witness said that there was a distinction between "cheap trains" and "workmen's trains." The cheap trains were those for which fares at 1d. per mile were charged, workmen's trains were those which were put on, after inquiries by the Board of Trade, with fares at a lower rate—in fact, the fares did not often exceed ½d. per mile. The Board of Trade had not had occasion to define the term "workman." Witness suggested certain matters into which he thought the Committee might inquire. The hour of departure should be fixed for the latest workmen's trains. They should also consider the advisability of running trains for workwomen who had to reach the City by, say, 9 o'clock. How far workmen's trains interfered with the ordinary passenger traffic of a line was another question. The term workman should be defined, and there should be a line of demarcation between cheap tickets and workmen's tickets. Other points were whether a fixed maximum rate could be laid down; whether "zone" or "flat" fares should be charged; the issuing of batches of tickets in advance; and whether railway companies should be called upon to run workmen's trains from sparsely populated districts. There had been several applications to railway companies for very early trains for Post Office officials, &c., and the companies had replied that they could not run such trains, as it would not allow them sufficient time for the proper inspection of the line.

On 30th ult. Mr. J. B. Meers, secretary to the Inland Revenue Department, gave evidence as to the remitting of the railway duty, and the Committee adjourned for the vacation.

North Metropolitan Electric Power Supply Bill.

The Select Committee of the House of Lords last week concluded its consideration of this Bill, which has been promoted with the object of empowering the U.D.C. of Willesden to sell, and the North Metropolitan Electric Power Supply Co. to purchase, the Council's generating station at Willesden at an agreed price. The Bill was opposed by the Metropolitan Electric Supply Co. and the owners of property in Willesden, but the Committee limited their right to be heard to such an extent that both petitioners came to the conclusion that it was not worth while to press their opposition further.

Formal evidence was given in support of the objects of the Bill.

The Committee found the preamble proved, and ordered the Bill to be reported to the House for third reading.

South Staffordshire Tramways.—Reporting to the House of Commons on the above Bill, the Deputy-Chairman states that Clause 31, which empowers the Wednesbury Corporation to grant a lease to the company, has been struck out of the Bill during its progress through the House of Lords, but the remaining clauses, authorising agreements with local authorities for certain purposes, were allowed by the Committee in the form submitted to them in accordance with precedents.

BUSINESS NOTES.

"Little Geeko."—The foregoing fancy title designates a little telephone outfit which has been put on the market by the General Electric Co., Ltd, for attachment to existing electric bell circuits. The method of connection is exceedingly simple; the bell-push serves to call attention in the lower regions, and when the instrument is in use the bell is automatically cut out of circuit. A variety of small fittings and accessories is listed, providing for different purposes.

Electrical Wares Exported.

Week ending Aug 5th, 1902.		Week ending Aug. 4th, 1903.	
Alexandria	Value £158	Alexandria	Value £91
Amsterdam	117	Amsterdam	46
Antwerp	205	Antwerp	34
Boca. Teleg. mat.	141	Beira	33
Bombay	93	Bilbao	12
Boston	80	Bombay	635
Buenos Ayres. Teleg. mat. ..	80	,, Teleg. mat.	62
,, Teleph. mat. ..	639	Boulogne	25
Calcutta	710	Buenos Ayres	90
,, Teleg. wire	462	Calcutta	279
Cape Town	269	,, Teleg. mat.	4,760
Channel Islands	18	Cape Town	1,869
Christchurch	68	Channel Islands	30
Colombo. 60 tons teleg. wire ..	—	Chemulpo	65
Copenhagen. Teleg. wire ..	192	Durban	440
Durban	1,027	,, Teleg. mat.	40
,, Teleg. mat.	780	East London	163
Fremantle	1,099	Hamburg. Teleg. mat.	610
,, Teleg. mat. ..	2,215	,, Teleph. apparatus. .	56
Gothenburg	183	Hong Kong	46
,, Teleph. cable ..	410	Kobe	29
Halifax. Teleg. cable	934	Melbourne	142
Hamburg. Teleg. mat... ..	20	,, Teleg. wire	1,371
Hong Kong	160	Montreal	21
Honolulu	20	North Atlantic. 100 knots telegraph cable	—
Lisbon	10	Oporto	49
Madras	16	,, Teleph. mat.	61
Nagasaki	67	Perth	218
Odessa	156	Rotterdam	970
Port Elizabeth	1,090	Seville	13
Rio Grande	18	Shanghai	105
St. Petersburg	35	Stockholm. Teleg. wire ..	64
,, Teleg. wire ..	44	Sydney	1,142
Santos	22	,, Teleg. mat.	477
Shanghai	51	Yokohama	359
Singapore	40	,, Teleg. mat.	70
Stockholm. Elec. cable ..	20		
,, Teleph. cable ..	174		
Sydney	1,802		
Vera Cruz	18		
Wellington	162		
Zanzibar	150		
Total ..	£13,955	Total ..	£14,423

Foreign Goods Transhipped.

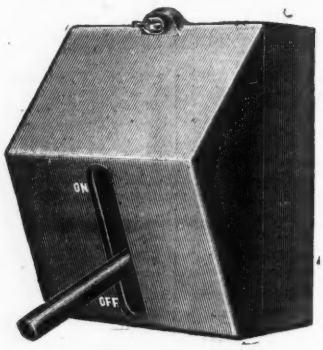
Cologne. Elec. instruments	Value £11	Kobe. Elec. apparatus	Value £131
Durban. Telephones	289	Nagasaki. Elec. mat.	51
Ghent. Elec. machinery ..	800	Perth. Elec. mat.	23
Hamburg. Elec. light apparatus	83	Shanghai. Elec. carbons ..	155
Total ..	£1,183	Total ..	£360

Miniature Enclosed Arc Lamp.—The accompanying figures show different forms of a miniature enclosed arc lamp which has just been put on the market by the Union Electrical Co., Ltd., 151, Queen Victoria Street, E.C. The lamp is very small, being 15 in. over all in length, and from 3½ in. to 5 in. in diameter, according to whether it is used with a pear-shaped globe and single enclosed arc, or a round globe and double enclosed arc. The lamp burns with 1½, 2 and 2½ amperes, and may be burned in single parallel on a circuit of 100 to 115 volts, or two in series on 200 and 230 volts. The mean hemispherical candle-power of the lamp is 160, with the smaller current, and up to 250 with the larger current. The trimming is so very simple that any housemaid can, it is believed, after half an hour's instruction, trim the lamp, and any intelligent workman can keep it in order. The working parts are

reduced to three in number—viz., the moving core, the upper carbon holder, and the simple clutch. The coils are differentially wound, and are totally ironclad, so as to be secure from damage. Owing to the constancy of the illumination and the steadiness of the burning obtained with these lamps, and the superior colour of the light, it is thought that they will largely replace the larger forms of incandescent lamps. In order to facilitate the introduction of the lamps into private houses, they are being specially fitted with glass and silk shades, but no doubt there is a very large field for the application of this lamp to the lighting, both inside and outside, of small shops, offices, depositors' desks, engravers' benches, and other places where fine and accurate work is carried on.

New Mercury Vapour Lamp.—A demonstration took place last week at the works of the Bastian Meter Co., Kentish Town, of a new mercury vapour lamp invented by Messrs. Bastian and Salisbury. It is claimed for the lamp that it yields an intensely brilliant white light, and requires no greater voltage than the normal supply from the street mains. The mercury becomes luminous directly the switch is turned. The inventors are forming a syndicate preparatory to launching a larger company to work the patent.

New Switches.—Messrs. Ward & Goldstone, of Dutton Street, Manchester, are supplying switches and fuseboards for high voltage, in cast-iron cases, the former similar to the accompanying figure. The switches are double-pole, with or without fuses, for currents from 20 to 100 amperes, and the fuseboards are of the clip



type, S.P. or D.P., the metal parts being mounted on insulated enamelled slates. Main fuses in cast-iron cases are also supplied, and a variety of accessories in the way of pendant and wall fittings, &c. The firm's new switchboard works are well equipped with the latest labour-saving machinery, and are totally separated from their wire-covering works.

Electric Pumping in Collieries.—The Elswick Coal Co., of Newcastle-on-Tyne, have, we understand, placed a contract with Messrs. Ernest Scott & Mountain, Ltd., of the Close Works, Newcastle-on-Tyne, for a complete electric pumping plant for their North Elswick Colliery. The plant consists of a Scott & Mountain horizontal low-speed three-throw ram pump, delivering 400 gallons per minute against a vertical head of 800 ft., driven by a Scott and Mountain multipolar direct-current electric motor of 130 effective H.P., the pump and motor being placed at the shaft-bottom and delivering to the rising main to bank. The current will be taken from the supply company's mains to the shaft top, then down the shaft to the pumps in-bye, the cables being of sufficient capacity to transmit 150 H.P. at 500 volts, and heavily armoured for protection in the shaft.

An installation of a somewhat novel character, recently secured by the same firm, is for an electric conveyor of the Brothers type for conveying the railway material from one side of the Victoria Falls on the Zambesi to the other, and also to be used in connection with the erection of a bridge which the Cleveland Bridge and Engineering Co. are supplying. The electric conveyor consists of a hoisting and travelling gear, which runs upon a wire rope, suspended from one side of the falls to the other, the distance being 930 ft.; the weight of the rope and load is supported at each end by balanced cantilevers. The wire rope is being supplied by Messrs. T. and W. Smith, of Newcastle, and the cantilevers and other work by the Cleveland Bridge Co. The current for driving this plant is generated by a portable steam engine and dynamo on one side of the falls, the current being conveyed across the falls by a hard-drawn copper conductor, and collected by rollers as the traveller runs along. Messrs. Scott & Mountain are also busy with other mining work, having contracts in hand for Walbottle Colliery, and the Consett Iron Co., Ltd., both these collieries being in the Newcastle district; for the Wigan Coal and Iron Co., Ltd., near Manchester; the Llay Hall Colliery, North Wales; and a number of other important contracts.

Church Lighting.—The Church of "Saint Jude's," Dulwich, is being fitted with an electric light installation throughout, by Messrs. Duncan Watson & Co., of 100, Charing Cross Road, W.C. The fittings are of a special character, unlike those generally used for church lighting, and will, it is believed, prove very successful. The same firm is also carrying out an extensive arc lamp installation for the Bon Marché, of Kilburn, several installations for Messrs. Slaters, Ltd., and many other important installations in town and country.

"Foster" Enclosed Arc Lamp.—In response to inquiries relating to this arc lamp, which was described in our last issue, the address of the makers is Messrs. Foster & Co., Worple Road, Wimbledon, S.W.

Schmidt & Bolton Superheaters.—We understand that Messrs. Easton & Co., Ltd., have recently secured orders for Schmidt & Bolton superheaters amounting in all to 9,000 H.P., one of the purchasers being the Metropolitan Electric Supply Co., Ltd.

Fire.—Last Friday night a fire broke out on the premises of Messrs. Spivey & Jubb, electrical engineers, Batley Carr, Dewsbury. The fire originated in the motor shed, and an alarm being promptly raised, it was quickly got under. The shed contained nearly 40 electric motors, a dynamo, two motor-cars and a motor-tricycle, the value of which was estimated at £1,200, the greater part not being insured. Some of the machines were got out little the worse for the fire, but others were considerably damaged.

Bankruptcy Proceedings.—A meeting of the creditors of Henry J. Furniss, electrician, of 5A, Queen Street, Derby, was held at the office of the Official Receiver at Derby on Friday. The statement of affairs showed gross liabilities amounting to £901 12s. 3d., of which £559 13s. 5d. is expected to rank for dividend. The assets were estimated to produce £73 15s. 7d. The estate was left in the hands of the Official Receiver.

Liquidations.—We have received a statement in *re* Rosling and Fynn, Ltd., of Trafalgar Works, Thornbury, Bradford, electrical engineers, showing the position of the estate at the date of declaration of first and final dividend. The receipts for plant, freehold works, and stock-in-trade, &c., amounted to £14,273 2s. 3d., and were applied in the payment of £11,008 13s. 4d. to the debenture holders, a first and final dividend of 5s. in the £ on the claims of unsecured creditors, absorbing £1,344 10s. 8d., and various law costs, wages, &c. The liquidator remarks that the costs and expenses of winding up the estate were considerably increased by the law and other expenses incurred by reason of the litigation consequent upon the action of the trustees for the first debenture holders, who took possession of the estate in December, 1902, and stated their intention to dispose of the whole of the property of the company for £10,500. Their conduct was brought under the notice of the High Court, with the result that the liquidator was enabled to obtain a much higher offer than the one mentioned. Creditors can obtain any furtner information by inquiry at the office of the liquidator, Mr. W. M. Gray, F.C.A., District Bank Chambers, Bradford.

The public examination of Mr. J. Yardley Johnston, an electrical engineer, of 13, New Bridge Street, took place on the 31st ult. It appeared that the debtor formerly carried on business in New York, and came to England in 1897 for the purpose of selling a patent for a printing machine. He had since promoted and been interested in a number of printing and engraving companies, which he financed. The debtor estimated that his assets would be more than sufficient to pay his liabilities in full. According to the statement of affairs the unsecured liabilities amounted to £43,305 17s. 6d. at the time of the receiving order, but this amount has since been reduced. The examination was ordered to be concluded.

Catalogues and Lists.—The Chloride Electrical Storage Co., Ltd., of Clifton Junction, near Manchester, have sent us a copy of their 1903 pocket catalogue of Chloride accumulators. The list contains in a compact form a mass of details respecting the various types of batteries for lighting, traction, yacht lighting, and launch service. Some notes on renewals are accompanied by tabulated details respecting sections, and portable cells are then particularised. Some elaborate tables showing rates of charge and discharge, weights and measurements for "C R" and "C R double" types of cells are given at the end of this handy-sized and useful list.

The Washington Chemical Co., Ltd., of Washington Station, Co. Durham, have issued a new pamphlet relating to their magnesia coverings. Among the numerous illustrations of places where these coverings are used is a photographic view of the interior of Leith electricity works. A very lengthy list appears of electric light, tramway and power stations—about 120 to 130—where magnesia coverings have been adopted.

Mr. F. H. Headley, of Moresk Mills, Truro, sends us a leaflet relating to his special line of D.P. high voltage distributing boards, fitted with clip fuses on porcelain bases.

We have received from Messrs. G. Hill & Co., of Trafford Electric Works, Cornbrook, Manchester, lists of their "Griffin" insulators for electric tramway lines, which consist of wrought-iron links covered with a special quality of ebonite, giving double insulation. Very high mechanical and electrical qualities are ascribed to these insulators. Another list describes the company's patent comb lightning arrester, in which the ordinary copper horns are replaced by facing rows of sheet iron horns.

Messrs. Geoffroy & Delore send us their new wires and cables catalogue and samples of their manufactures. The latter are of very high quality, and include a specimen of twin lead-covered cable, insulated with vulcanised rubber, of which large stocks are carried by the company, from 1/18 to 7/14 gauge. The list comprises wires and cables of all ordinary sizes up to 37/12, insulated with vulcanised rubber in three classes, and flexible cords of similar make and quality.

We have received from the Walsall Electrical Co., Ltd, a copy of their new catalogue of arc lamps and accessories, all of which are manufactured at Walsall; these include open and enclosed lamps in various forms, lamps for inverted arc lighting, measuring instruments, cut-outs, suspension gear, &c. We have also received their pocket price-list of open-type "Walsall" dynamos and motors from 1 to 60 KW.

Messrs. Easton & Co. have sent us a neat and useful case enclosing an A B C railway guide for August; the inner covers are devoted to artistic illustrations of their express electric passenger and goods lifts, which are British built throughout, and are designed to suit all requirements.

Mr. G. Braulik sends us new price lists dealing with "Eclipse" electricity meters for direct and alternating currents, registering either energy or quantity, and of all sizes from 2½ to 2,000 amperes. Another list is devoted to miniature arc lamps, suitable for shop and house lighting; these take currents of 1 to 2 amperes, and are arranged for burning singly or in series, with enclosed arcs. The lamp is provided with a cover and reflector, suited to the purpose for which it is intended, and has a very neat appearance.

Annual Outing.—On Saturday last the employés of Messrs. T. Clarke & Co., of Sloane Street, went for their annual outing to Bognor. The weather was excellent, and a thoroughly enjoyable day was spent. Breakfast at the Waterloo Hotel was done full justice to at 9 a.m., and the morning was spent at a very amusing game of cricket. At 2 p.m. the men met for dinner, after which Mr. Edward Clarke proposed "The King." Mr. Topham then proposed "The Firm," and in reply, Mr. E. Clarke thanked them all most heartily for the kind way they had responded to the toast. A vote of thanks was passed for the able manner in which Mr. Blake, the secretary of the outing, had carried out the arrangements. After tea a short concert took place, and the party left Bognor at 8 o'clock.

Fire at Davies Street Works.—A fire occurred at the Davies Street electricity works of the Westminster Electric Supply Corporation, Ltd., on Monday morning, which at first was represented by the daily Press to be a serious one. We are informed, however, that it was confined to a carpenters' shop and store. No damage of any sort, either by fire or water, was done to any of the machinery or mains in the building, and the supply was not at any time interrupted. In spite of the dense smoke which was caused by the burning of the wood in the carpenters' shop, the staff in the station kept all their machinery running. The corporation is to be congratulated upon its happy escape from what might have been a very disastrous occurrence.

Trade Announcements.—Mr. S. E. Bastow informs us that he has resigned his appointments as borough electrical engineer, and resident engineer to the Barnsley and District Traction Co., and will shortly open offices in Manchester for Messrs. D. Bruce Peebles & Co., Ltd., as their representative for the Manchester district.

Messrs. Gent & Co. announce their removal to more commodious premises at 3A, Upper Thames Street (two doors from St. Paul's Station).

The Post Office and Motor-Vans.—With the object of ascertaining whether a trustworthy parcel service can be run in districts within easy reach of London, the Post Office authorities have started a series of experiments with motor parcel vans. Several of these leave the Mount Pleasant office nightly for Epping, Redhill, and other outlying districts, and up to the present the trials have proved satisfactory. The majority of the new vans are driven by petrol, but one of them is propelled by electricity. An experiment has also been made with a motor-van for parcel work within the City, by which, it is believed, much time may be saved.—*Times.*

Book Received.—"Transactions of the American Electro-chemical Society," Vol. iii. The American Electro-chemical Society, 929, Chestnut Street, Philadelphia.

ELECTRIC LIGHT AND POWER NOTES.

Birkenhead.—An abstract of the borough accounts for the year ending March 31st last, has been issued. The receipts of the Electric Lighting Committee appear as £1,195, and of the Tramways Committee £3,598. On capital account the disbursements included:—Tramways, £43,742; electric lighting, £19,407. On the tramways the gross earnings over working expenses was £22,509, of which interest and sinking fund took £18,910 15s., and £3,598 7s. 9d. was put to renewals account. The balance of £1,195 on the electric lighting account was also carried to renewals account.

Bradford.—An interesting conflict is in progress between the Electricity Committee and the Tramways Committee. The Electricity Committee recently decided to advertise for a successor to Mr. Chattock, who received the Birmingham appointment, but the City Council referred the recommendation back, on the ground that the advisability of appointing a joint manager of the electricity and tramway departments should be considered. The Tramways Committee afterwards met and passed a recommendation that the Corporation should combine the two offices and amalgamate the two Committees; but the Electricity Committee has also met and reaffirmed its previous decision to advertise for an electrical engineer at £600 a year. There is a strong feeling between the two Committees, and a full dress debate is anticipated at the next Council meeting.

Burslem.—At a recent meeting of the T.C. it was decided to apply to the Local Government Board for sanction to borrow £20,000 for the purposes of the electric light undertaking.

Chorley.—At the monthly meeting of the T.C. the Special General Purposes Committee recommended that "the Chorley Electric Lighting Order, 1898, be disposed of to the best advantage." An amendment was subsequently moved and carried, to refer the subject back to the Committee.

Dublin.—The Electric Lighting Committee has decided to secure Mr. Hammond's services in connection with the change-over to the new electric plant. The terms of this new agreement are now coming up for ratification by the Council. They provide that Mr. Hammond shall take charge of the working of the system for a year at a salary of £1,000 and travelling expenses; and further, that he shall be allowed to appoint his own staff for the work.

Dartford.—The Board of Guardians has asked the U.D.C. to prepare an estimate for installing the electric light in the Workhouse.

East Ham.—A Local Government Board inquiry has been held as to the application of the Council to borrow £5,660 for electrical extensions. No opposition was offered to the application.

Farnborough.—The B. of T. has decided to defer consideration of the question of revoking the prov. order until October 31st next.

Germany.—The establishment of a municipal central electric lighting station in the town of Zeitz has been decided upon.

Hanley.—The T.C. has applied to the L.G.B. for a loan of £600 for the provision of three steam superheaters for the electricity works.

Kingston-on-Thames.—The T.C. has appointed Messrs. Burstall & Monkhouse as advising engineers respecting the extensions of the plant, &c., at the electricity works.

Leicester.—The T.C. has applied to the L.G.B. for a loan of £100,000 for electricity purposes.

Liverpool.—The Lord Mayor's auditor and the elective auditor of Liverpool have presented their report on the accounts of the city for 1902, to the Finance Committee. Speaking of the accounts of the Electric Supply Department, the report states that the accounts, after paying interest, show a credit of £61,141 14s. 8d. This had been dealt with as follows:—Sinking fund, £27,726 5s.; reserve fund, £10,000; renewal fund, £11,386 9s. 8d.; contribution to rates, £12,029. There was £83,243 19s. to the credit of the sinking fund. The loans, the repayment of which is provided by the sinking funds, are for periods of 42 and 25 years, £500,000 being for 42 years and £1,000,000 for 25 years. As regards the value of the assets, the amounts expended by the Corporation were: Mains, £377,549 9s. 5d.; machinery, £267,121 19s. 5d.; accumulators, £8,617 9s. 11d.; meters, £20,221 0s. 6d.; electrical instruments, £3,648 9s. 1d.; total, £677,158 8s. 4d. The old company's mains and machinery were £214,578, making £891,736 8s. 4d. Garston undertaking: Station mains and machinery, £39,069 4s. 1d.; total, £930,805 12s. 5d. The engineer had reported that the depreciation on mains was very slow, and that it was more than provided for by the sinking fund. The amount transferred this year for reserve and renewals was £21,386 9s. 8d., equal to about 2·30 per cent. on the capital expenditure of £930,805, which was in addition to the sinking fund.

London. — HAMPSTEAD. — At the B.C. meeting on Thursday of last week, the chief electrical engineer reported that during the year ending March 31st, 1903, 2,592,474 units had been sold, the working expenses being £17,390. For the previous 12 months the figures were 2,127,173 units and £16,785 working expenses. It would thus be seen that the works cost per unit had been reduced from 1·89d. to 1·61d. The reduced price of coal accounted for ·12d. of this decrease. In 1901-2 the actual average total cost (including interest and sinking fund) per unit, was 4·06d., while in 1902-3 it was 3·92d. The actual average revenue per unit sold was in 1901-2, 4·34d., and in 1902-3, 4·33d. The borough electrical engineer reported that the receipts from the electricity undertaking for the Midsummer quarter just ended, was £6,850 11s. 3d., as against £5,853 5s. 4d. in the corresponding period last year. A discussion took place as to the danger of fire to consumers' premises from meter readers using ordinary matches when reading the meters and indicators. It was resolved to provide the readers with "ever-ready" electric torches with refills. A motion was adopted that objection be offered to the Bill to authorise the Board of Trade to grant Provisional Orders for the supply of electricity in bulk by companies to local authorities, and with reference to the compulsory power of purchase of land for generating stations.

WESTMINSTER.—The City Council on Thursday of last week condemned the action of the Board of Trade in not sanctioning the application of the London Electric Supply Corporation for an extension of its area over the southern portion of the Borough of Camberwell. The following resolution was passed:—"(1) That a letter be addressed to the members of Parliament representing the City of Westminster asking them to support the action of the members for Camberwell in raising the above-mentioned question in the House of Commons at the consideration of the estimates for the Board of Trade. (2) That a communication be addressed to the Board of Trade stating that this Council is of opinion that prov. orders to electric supply companies should be so framed as to render it unlawful for companies having powers of supply in one district to combine for the prevention of competition."

HAMMERSMITH.—The B.C. on Wednesday resolved to increase the insurance on the electricity station and contents from £20,000 to £25,000.

MARYLEBONE.—The B.C. has decided to apply to the Board of Trade for a license authorising the Council to supply electrical energy for public and private purposes within the borough. The object of the application is to enable the Council to borrow the sum needed for completing, under the arbitration award, the purchase of the Marylebone undertaking of the Metropolitan Electric Supply Co.

KENSINGTON.—On Tuesday the B.C. granted, under the usual protective conditions, main extension applications by the Notting Hill Electric Lighting Co., and the Kensington and Knightsbridge Electric Lighting Co.

Maidenhead.—The Thames Valley Launch Co. has applied to the Town Council to put in a motor transformer at their station at Boulter's Loch, to supply craft with electricity at 100 volts. It was resolved to do this, conditional upon the company agreeing to take a minimum supply of 6,000 units per annum, and to pay a rent of 7½ per cent. upon the estimated capital outlay, £250. The Electromobile Co. wrote to the Town Council asking that housing accommodation should be provided for the cars when charging, and the electrical engineer reported that the business of charging was a growing and profitable one. It was decided to comply with the request.

Malton.—At the last ordinary meeting of the U.D.C., it was stated that a letter had been received from the Board of Trade intimating that they would not disregard the protests of the Council against the delay of the Northern Counties Electricity Supply Co. in carrying out their contract for lighting Malton, and if some practical steps were not taken by the company within the next six months, the order granted them would be cancelled.

Manchester.—A correspondent of the *Manchester Courier* draws attention to some anomalies produced by the present mode of charging for electricity for motive power. The scale of charges is as follows:—

	Per unit.
For less than 150 units per H.P. per quarter	1¾d.
For 150 units and below 200 per H.P. per qr.	1⅝d.
For 200 „ 250 „	1½d.
For 250 „ 300 „	1⅜d.
For 300 „ 350 „	1⅜d.
For 350 „ 400 „	1¼d.
For 400 „ 450 „	1⅛d.
For 450 and upwards „	1d.

A little calculation will show that a consumer of 149 units per H.P. per quarter will pay for them £1 3s. 1d., whereas if he used 150 units they would only cost him £1 1s. 10½d. If he consumes 199 units the charge would be £1 9s., while for 200 he would only have to pay £1 7s. 1d. If his consumption increases and amounts to 299 units, the cost will be £1 17s. 5d., but by the benevolence of the Electricity Committee he can use 151 units more—viz., 450 units at the extra cost of only 1d., viz., for £1 17s. 6d. Take the cases of four different consumers, each with 100 H.P., who use respectively (A) 299 units per H.P., (B) 300, (C) 400, and (D) 450. Their charges work out:—

A. 29,900 units at 1¼d.	... £186	17	6
B. 30,000 units at 1⅜d.	... 171	17	6
C. 40,000 units at 1⅛d.	... 187	10	0
D. 45,000 units at 1d.	... 187	10	0

It must be clear to everyone that a scale which makes the cost for 29,900, 40,000, and 45,000 units practically identical must be unjust to somebody, and that somebody is the Electricity Department itself.

The following recent particulars of the electrical undertaking are of interest:—There are now 20 sub-stations, of which 12 are within the city and the remainder in the districts which the Corporation have agreed to supply with current. The total length of mains at the end of the last financial year exceeded 288 miles of actual main and 633 miles of single cable (exclusive of service cable). The capital expenditure on mains amounts to £670,000. The area supplied by the present mains is approximately 18 square miles, but as the total area in which the Corporation have power to supply current will embrace 43 miles, the work of the department cannot yet be regarded as approaching completion. During the past 12 months the units of electricity sold for lighting and power purposes were 9,352,000, and for traction purposes 7,986,000, a total of 17,378,000. It is estimated that in the current year the total sales will reach 26½ million units, and should that prove correct the Manchester Electricity Department will supply a greater quantity of electric energy than any other electricity undertaking in the kingdom.

Mutford and Lothingland.—The Board of Guardians has engaged Messrs. Barber & Croft, of Oulton, to prepare an estimate for installing the electric light and supplying current to the hospital.

New Zealand.—The New Zealand Government intends to make use of a waterfall called the Huka Falls, in North Island, for the purpose of generating electricity. A Swiss engineer from Berne has been engaged by the Colonial Government to construct a generating station on the falls. It is estimated that sufficient power will be obtained to light the principal centres in the North Island and to supply power for the tramway systems.

Newark.—The electric light agreement between the Corporation and the Notts and Derbyshire Power Co. has been completed. The company has refunded the Corporation all the expenses it had been put to, and has taken over the site previously purchased by the Corporation for its own undertaking.

North Wales.—The North Wales Power and Traction Co., Ltd., has been formed to utilise the water of the lakes around Snowdon for the generation of electrical power, to work the partly-constructed railway from Portmadoc to Lake Goynant, for lighting Portmadoc, Criccieth and other towns, and for industrial purposes. Mr. S. B. Cottrell, of the Liverpool Overhead Railway Co., has reported on the scheme, and estimates a revenue of £19,000 per year, without the profit on the surplus energy, which he considers should give further revenue of about £60,000. A share capital of £270,000 is to be offered for public subscription.

Norwich.—On the recommendation of the Electricity Committee it has been decided that the land-tax on the property of the undertaking, including the land known as Camden Yard, be redeemed at an estimated cost of £680 7s. 6d.; and the Finance Committee will be authorised to pay the required amount out of the capital already raised on behalf of the undertaking.

A fault in one of the Corporation electric light mains near St. Stephen's Plain caused considerable inconvenience to electricity consumers in the central portion of the city for about half an hour on the evening of the 28th ult.

St. Albans.—Mr. E. MacGregor Duncan has been appointed consulting engineer to advise the Corporation of St. Albans in connection with its electric lighting undertaking.

Southborough.—The U.D.C. has decided to oppose the application of the Southern District Electric Corporation for a prov. order to supply the town with electricity. The Council hopes to obtain a supply from either Tonbridge or Tunbridge Wells.

Stokefleming.—The Parish Council has decided to approach the Urban Electric Light Co., Dartmouth, with regard to their terms for lighting the village.

Todmorden.—The B. of T. has postponed for a year the consideration of the revocation of the T.C.'s E.L. order.

The electrical engineer (Mr. H. Waring) has been instructed to prepare sketch plans of a combination of electricity works with refuse destructor.

Turkey.—An electrical power transmission plant is being put down in connection with the silver lead mines of the Société des Mines de Balia-Karaidin, Turkey.

Walton-on-Thames.—The U.D.C. has decided to ascertain whether the Weybridge Electric Light Co. is prepared to supply electricity to the town.

West Bromwich.—As a result of tests during the last few months for the purpose of deciding which of the two illuminants—gas or electricity—is the better for public lighting, the Highway Committee recommends that electric lighting, by means of two 1,000-C.P. arc lamps on alternate poles, be adopted from Carter's Green to the Beeches Road, and the existing gas lamps removed. The net cost will be £600 per annum.

Wigston.—The E.L. Committee reported that it was arranging for a deputation to visit Melton Mowbray, and also recommended the Council to authorise it to go to Fleetwood, St. Anne's-on-Sea and Kendal, to inspect the electric light works at those places, and to obtain further information for the use of the Council.

Willesden.—The District Council at the last meeting sanctioned main extensions to the estimated cost of £2,448.

ELECTRIC TRACTION NOTES.

Batley.—The Corporation's abstract of accounts for the year ending March 31st last contains, for the first time, a tramway account. The Corporation have recently completed the construction of electric tramways in the borough, the official inspection of which took place last week. As cars had not yet commenced to run, no revenue is shown. Up to the end of March the expenditure amounted to £28,489, representing wages, contracts, &c. The loans borrowed in respect of the tramways at the end of March amounted to £17,600. The electricity supply account is also a new one, and shows expenditure only. The works are now about completed, and the Corporation hopes to be in a position to supply electricity in the course of a few days. Up to March 31st last £14,295 had been paid out, £11,013 by expenditure during the past 12 months.

Bradford.—Last week Joseph Drake, aged 62, a commercial traveller, sued the Mayor and Corporation of Bradford for damages in compensation for injuries caused by a tramcar accident in Bradford. The amount claimed was £2,000, and the sum of £500 had been paid into court.

On September 1st, 1902, plaintiff took one of the Bradford cars, having its terminus at City Square. Instead of slowing down at a corner, the car was run at full speed, with the result that the trolley pole came off the overhead wire, and became entangled with the wires. A wire broke and fell on to the car, and the plaintiff, who was sitting near the trolley pole, received a shock. There was no blow or impact by the pole or the wire, the injury to plaintiff's constitution being entirely due to the shock received. In consequence of the shock, plaintiff had to give up business, and had incurred considerable expense in doctor's fees and enforced holidays at the sea-side.

Asked as to the nature of his suffering at the present time, plaintiff said he suffered from nervousness and want of sleep. He always felt as if he was drunk, and he had also a pain in one side and one leg, and his foot was numb.

Dr. Johnson and Dr. Campbell gave evidence as to the plaintiff's condition. Both witnesses concurred in the opinion that the shock had resulted in slight cerebral hemorrhage, which would produce a certain unsteadiness in motion, numbness in the limbs, &c.

The driver of the car, in his evidence, denied that the car was going at a great speed. The trolley pole came off the wire at a junction,

and striking one of the arms of a standard, pulled the trolley stanchion over.

Dr. Lodge and Dr. Jessop, who had examined plaintiff, said he was suffering from kidney disease. The affection of the kidneys was in no way connected with any shock or fright. A shock such as this could not produce cerebral hemorrhage unless the brain was diseased.

The jury found for the plaintiff, and assessed the damages at £450.

Birkdale.—The new "Demi" car which was inspected by Major Druitt, of the Board of Trade, on 29th ult., when he inspected the Trafalgar Road extension of half a mile, is estimated to be worked at a cost of 2¼d. a mile. It is the first car of its kind in this country, one man being able to fulfil the duties of both driver and conductor. The passenger, on entering, puts a penny in the slot, and the driver raises a bar which stops the current temporarily. Passengers have to enter and leave by the one door at the front of the car. Major Druitt said he highly approved of the new car.

Birkenhead.—New tramway offices which have been erected by the Birkenhead Corporation at a cost of £3,355, were formerly opened on Tuesday afternoon by the Mayor of Birkenhead, Dr. R. Owen Morris. Prior to the opening of the building, members of the T.C. met at the Woodside Ferry terminus, and taking their seats on two decorated electric cars, were conveyed over the different routes and to the generating stations, and ultimately to the new offices, where, after the formal opening of the building, dinner was served. After dinner it was stated that during the two years of their existence the tramways had paid all working expenses, interest and sinking fund, and the Committee had put by about £7,000 towards depreciation and renewals. Whereas in 1901 the average number of passengers carried weekly was 163,000, last year the average was 210,000, and the weekly receipts grew from about £1,000 to £1,100 per week. They hoped to increase their profits this year by another £5,000.

Glasgow.—The ninth annual report by the Tramways Committee of the Glasgow Corporation was issued at the end of last week. The report includes an abstract statement of revenue and expenditure for the year ending May 31st, 1903, together with the capital expenditure account and balance-sheet. The account of the year's working shows that the revenue amounted to £656,572, and the working expenses, including depreciation, to £431,870, leaving a gross balance of £224,702. The revenue of the previous year was £614,413, and the working expenses, &c., £405,103, leaving a gross balance of £209,310. This year's gross balance thus shows an increase of £15,392. The gross balance of £224,702 has been applied in meeting interest and sinking fund, &c., on the cost of the Govan and Ibrox tramways, interest on capital, sinking fund and annual payment to the Common Good; these payments amounting in all to £124,425. The net balance remaining amounted to £100,277, out of which an extra payment of £10,000 has been made to the common good. On account of the high rates prevailing for electrical material during the period of construction, £40,000 had been written off the cost of feeder cables and overhead equipment. £25,000 had been written off the cost of buildings originally constructed for horse traction. The balance, amounting to £25,277, had been added to the general reserve fund. The revenue account, although £40,374 in excess of the previous year, worked out at ·47d. per car-mile less. The working expenses, however, showed a decrease of ·31d. per car-mile. The total borrowing powers granted to date amount to £2,043,198, of which £1,889,312 has been exercised. The gross capital expenditure of the system amounts to £2,754,855, and the actual capital expenditure to £2,129,512. The average number of street miles of lines open for traffic is 119, while the population served by the tramways (city and suburbs) is 1,000,000. The sinking fund has been increased by £43,294 0s. 7d. The car-mileage for the year was 14,008,750, and per car per day 96·78. The number of cars operated per day per mile of single track was 3·36, and the average cars in use per 16-hour day were 399·58. The passengers carried were 177,179,549, the average traffic revenue per car-mile was 11·19d., and the average total revenue per car-mile 11·25d. The average working expenses per car-mile, including depreciation, were 7·40d. The average fare charged per mile was ·45d., the average fare per passenger ·88d., and the average number of passengers per car-mile 12·64. The percentage of working expenses to receipts was 46·35d. During the year 13½ miles of track were opened. The total length of tramways, including the foregoing extension, owned and leased by the Corporation amounts to 64½ miles, 4 miles of which only is leased. The only addition to the electrical plant was at Coplawhill substation, where an extension was made to the switchboard for the purpose of dealing with the energy supplied to the Electricity Department of the Corporation. The total cost of repairs to the power plant and sundry machinery during the year was £4,250. In addition, £20,555 was charged against revenue to meet depreciation. The total number of electric cars in stock is 611. This includes 120 of the old horse cars, which have been electrically equipped. At present 70 additional cars are in course of construction; 100 cars have been fitted with the Westinghouse electro-magnetic track brake, under an arrangement by which all the cars will be fitted with these brakes if the first 100 prove satisfactory after 12 months' trial. The total cost of inspection and repair of cars at the car-sheds and workshops throughout the year was £27,530, and a further sum of £25,087 was charged against revenue to meet depreciation.

Heavy Woollen District.—Major Druitt, R.E., last week formally inspected the electric tramways in Batley, an extension of the British Electric Traction Co.'s system from Millbridge (Heckmondwike) to Hightown (Liversedge), and a further extension of the company's system from the Dewsbury boundary through Ravensthorpe to the Mirfield boundary. The lines at Batley have been constructed by the Corporation and leased to the British Electric Traction Co., who now control all the tramways in the Heavy Woollen District. There are now through lines from Dewsbury to Cleckheaton, Thornhill and Ravensthorpe, in addition to about five miles of track in the Borough of Batley, which are connected with the Dewsbury and Spen Valley system. The cars have not yet arrived for the Batley lines, but it is expected that until these are received Spen Valley cars will be brought into service. An accident happened to one of the two trial cars at Batley. Going down Purlwell Lane, the front car, which had slowed down, was run into by the second car, and both were damaged. The driver of the first car was knocked down and his collar-bone broken. Mr. O. J. Kirby, borough surveyor, of Batley, who was standing near the cars after the collision, was knocked down by a passing trap and slightly injured.

Halifax.—The T.C. has instructed the borough engineer to proceed with the extension of the tramways from Hove Edge to Brighouse (nearly two miles), at an estimated cost of £10,378 13s. 9d.

Huddersfield.—A new system of merit stripes, devised by Mr. H. N. Thomas, the general manager, has been introduced on the electric tramways, with the unanimous approval of the men. No employé is to be granted a stripe until he has given entire satisfaction for two years. In order that merit could be rewarded in beginners, all new conductors would start at 5d. an hour, rising by the end of 18 months to 5½d.; and at the end of two years' service they would obtain a merit stripe carrying with it 2d. per day extra pay. New motormen would start at 6d. per hour, rising in 12 months to 6½d.; and at the end of two years' satisfactory service they would obtain a merit stripe with 2d. per day extra pay. Under the old system, beginners started at the maximum pay, and no opportunity existed for rewarding meritorious service.

Lancaster.—At a meeting of the Lancaster T.C. on Wednesday, July 29th, it was decided to refer back the proposal of the Tramways Committee to construct a new route past the Castle Station to Lime Road, returning through the business portion of the town to the terminus in Dalton Square. The scheme was estimated by Mr. Tester, the electrical engineer, to cost £13,100, irrespective of cars. Mr. Alderman Bell, who proposed the successful amendment, said that the tramways were costing more than the revenue justified. In order to widen Bowerham Lane £1,061 was being spent, and it had also been decided to double the line from Thurnham House (the tram offices) to the Pointer, which is the first halfpenny stage, at a cost of £1,610. The traffic returns for the past month showed that 71,846 passengers had been carried over the Scotforth route, the receipts being £261, and 40,707 over the Park route, producing £195. He estimated that unless there was a big increase in the number of passengers to the Park they would have a loss.

Liverpool Overhead Railway.—A burn-out took place on the railway between the Prince's Dock and Pier Head stations on Wednesday last week, due to a short-circuit in a controller, and resulted in a temporary stoppage of the traffic. No harm was done; the passengers left the train and walked back to the station. The local papers were as usual greatly upset, as may be gathered from the following eloquent passages:—"The driver of the train and another official in uniform deserve the utmost credit, especially the former, who remained in his place—a mere box—until all immediate danger was past, notwithstanding that flames were hissing and belching forth repeatedly." "The chief of the brigade arrived in a hansom cab, and at once superintended the operations, which even after his arrival were sufficiently startling when the current was turned on, and afforded the hundreds of spectators in the street a view of flaming volts, which gave a vivid idea of how easily a terrible tragedy might have been enacted." Terrible, indeed! !—terrible nonsense.

Liverpool—Southport.—The work of installing the conductor rails from Southport to Liverpool in the electrification of the L. and Y. Railway is rapidly nearing completion, and the generating stations are almost ready for the machinery. At present the service between Liverpool and Southport is every 15 minutes; it is probable that with the electric trains there will be a service every eight minutes. The chief generating station is at Formby, and substations are being erected at Birkdale and Seaforth.

London.—Lewisham.—As a preliminary to resuming negotiations with the L.C.C., the B.C. has rescinded a resolution refusing to contribute to the cost of the street widenings which would be rendered necessary by the proposed tramway extensions.

L.B. & S.C. Railway.—The chairman of the L.B. & S.C. Railway recently stated that the board of directors was actively pursuing its inquiry into the subject of electric traction, and a Committee had been appointed for its special consideration. The problem is a very difficult one so far as this railway is concerned, by reason of the complication of lines and the intermixing of main and local, or fast and slow, traffic. It is necessary for the board to be assured that electrical traction will be a success from its commercial as well as its mechanical aspect; it is, therefore, advisable to proceed with caution.

Manchester.—The annual report of the Tramways Department of the Corporation, just issued, is an interesting document.

The traffic revenue for the year amounted to the sum of £306,250; there was received for rent of lines, £11,234, and other small items of revenue, amounting to £476, brought up the total gross income of the department to £317,960, as compared with £111,308 in the preceding year. The increase is accounted for by the greater length of tramways now in operation. In March, 1902, there were open for traffic 20⅓ miles of single track. Between that date and March, 1903, several new routes were opened, including those on the southern side of the city, making the total length of single track over 77½ miles. The working and other expenses of the past year amounted to £193,989, against £64,689. The balance, being gross profit, was £123,971—a leap, in 12 months, from £46,619. With bank interest, &c., added, the sum available is £126,567, of which £39,968 is appropriated to interest on mortgage debt, &c.; £3,545 for rent of lines leased; £30,000 is handed over to the City fund, in relief of rates, and £39,551 is set aside for reserve, renewals and depreciation. In 1901-2 the total cost of working, per car-mile, was 8·10d.; last year it was only 6·95d. The cost of electric energy rose from 1·45d. per car-mile, in 1901-2, to 1·94d. in 1902-3. Traffic expenses have, however, fallen. The total per car-mile last year was 3·53d., as against 4·24d. in the previous year. Management expenses have fallen from 1·80d. per car-mile to 0·75d. Repairs and maintenance cost slightly more last year than in 1901-2, the total charges under these heads being in 1902-3 ·73d., against ·61d. The total car-mileage run between March, 1902, and March, 1903, was 6,382,036; the number of passengers carried during the 12 months was 66,849,457; and the average receipts per car-mile were 11·52d. The year's working has been so successful that the Committee felt justified in making a revision of the fares on most of the routes favourable to the public. The fare to Heaton Park, Manchester's latest and most extensive public playground, is reduced from 2½d. to 2d. The distance from the centre of the city to the park is about five miles. The weekly traffic receipts average over £12,000, and the number of passengers carried is nearly 2½ millions.

An important extension of the tramway system is in progress. It consists of a new route to connect the northern and southern portions of the city. Commencing at Newton Heath it will proceed by way of Pottery Lane, Openshaw, and Gorton Lane, to Reddish, where a junction will be formed with the existing lines on the Manchester and Stockport road. Ready access will thus be given to either of those towns, to a large outlying population.

Manchester—Liverpool High-speed Railway.—The directors announced last week that the number of applications received for shares would not justify them in going to allotment. The capital required is £2,100,000. A large number of applications was received from small investors, but no application exceeded £1,000, and it is evident that capitalists have fought shy of the venture. It is not, however, intended to abandon the issue, and cheques will not be returned unless they are asked for. It is hoped that sufficient capital may yet be forthcoming to carry out this important experiment, which, if successful, would be of great benefit to the electrical industry.

Newcastle-on-Tyne. — The Corporation Tramways Committee has, subject to the approval of the T.C., decided to increase the salaries of tramway officials as under:—Mr. Le Rossignol, general manager, from £750 to £1,000 per annum; Mr. Confer, traffic manager, by £100 a year; Mr. Fleming, assistant manager, from £200 to £250 per annum; Mr. Easten, chief clerk, by £50 a year.

Nottingham.—Complaints having been made from time to time to the Corporation about the slow pace made by the electric tramcars, the authorities are endeavouring to induce the B. of T. to allow them to increase the pace in various parts of the city. The maximum speed hitherto allowed varies from 4 to 10 miles an hour, and it is now desired that on certain routes, such as Basford and Bulwell, Sherwood and Lenton, the cars should be permitted to reach a maximum of 12 miles an hour. These are all wide thoroughfares, with very little vehicular traffic. It is pointed out that the limits were recently increased at Bradford by a couple of miles all round, and that in some towns cars are permitted to travel on certain routes at 14 or 15 miles an hour.

With the opening of the Market Street and Hartley Road sections the Corporation brought to completion the whole of the electric tramways for which it obtained Parliamentary powers in the first instance, excepting a short length of line in Wells Road, which there is no present intention of constructing, the rate of development in that district not yet warranting the undertaking. Under the powers which it obtained in the second instance the Corporation has yet to construct the lines along Forest Road and London Road, but these are not to be taken in hand at present. The opening of the Market Street line has enabled the Corporation to make a number of important alterations in the general tramway service in the city.

Oldham.—The B. of T. has given the T.C. permission to borrow £79,969 for tramway purposes. In all £100,000 was applied for, but the B. of T. refused to sanction £21,084 for side paving.

Paisley.—The agreement between the Paisley Tramways Co. and Mr. W. M. Murphy for the purchase of the present horse system has been signed. One of the conditions is that the purchase price is to be paid within two months. In a letter sent by Mr. H. F. Parshall, London, one of the promoter's consulting engineers, to Mr. Parkinson, Paisley electrical engineer, he states that in his opinion part of the new lines will be open for traffic by the end of March next, and the whole system by June following.

Wolverhampton.—A meeting of the T.C. was held on Saturday last, at which there was a long and unpleasant wrangle respecting the continued unsatisfactory condition of the town as regards the tramways. The discussion arose on an attempt by Councillor Dickenson to "draw" the Tramways Committee as to the position of the so-called negotiations between the Corporation and the Lorain Co. In the course of the discussion one or two facts were gleaned. One was that at no time since the differences between the Corporation and the company had arisen had the latter made any overtures to the Corporation either in Wolverhampton or in London. On the other hand, the company had always insisted that proposals should come from the Corporation, and that they should be in writing—so Alderman Gibbons, one of the sub-committee appointed to meet the company, stated. It was also elicited that before anything further can be done towards a settlement of the matters in dispute, the agent of the company in Wolverhampton (Mr. Wetmore) will have to pay a visit to America for consultation with the company. It is probably in view of this visit that Mr. Wetmore was one day last week, in company with the deputy-chairman of the Tramways Committee (Alderman Craddock) and the Corporation electrical engineer (Mr. Shawfield), examining the track and the contact boxes. It was further elicited in the discussion that during the last month (April) for which a statement of the working of the electric tramways had been submitted to the Committee, there had been a loss of £150. It was suggested that the Tramways Committee—which had not met for a month—should be called together to consider the whole situation. Councillor Jones, however, said he did not think it was any use calling on the Tramways Committee, who, he declared, ought to have "the sack," and a fresh Committee be appointed. Alderman Craddock protested against "such silly talk;" and Alderman Mander (the chairman of the Tramways Committee) protested, on the other hand, against receiving instructions. He had already, he said, had sufficient instructions. Finally, it was decided, by 14 votes to 7, that the Tramways Committee be called together, with instructions to establish communication with the outside districts without delay, and that a special meeting of the Council be held early in September to deal with the Committee's report. The month of August, it may be stated, is always regarded as a holiday month, and meetings of the Corporation are not held. It may also be pointed out that it was on May 20th that the Council passed the resolution in favour of throwing over the Lorain Co. Nearly three months have elapsed since then, and nothing has been done to carry out the decision of the Council.

TELEGRAPH AND TELEPHONE NOTES.

International Conference on Wireless Telegraphy.—The conference was opened at Berlin on Tuesday last by Herr Kraetke, Imperial Secretary of State for the German Post Office, who alluded to the importance of wireless telegraphy at sea, and said that it was the result of the labours of many scientific investigators. The object of the conference was to clear the way for the free expansion of the system for the common benefit of all who use the sea, by the harmonious co-operation of the various Governments concerned. The proceedings are being conducted in private.

The Telephone and Truth.—The *Daily News* reports a discussion at the Leeds Assizes between Mr. Justice Grantham and King's Counsel, as to conversations alleged to have taken place over the telephone. The Judge: The telephone is often the biggest liar out.—Mr. Tindal Atkinson: I don't think it is the telephone, my Lord.—The Judge: The conflict of evidence revealed during these Assizes as between one man at one end of the telephone and the other at the other end is most extraordinary.

We offer our respectful sympathy to his Lordship.

Wine Testing by Telephone.—According to the *Daily Telegraph*, M. Maneuvrier, Assistant-Director of the Laboratory of Researches of the Paris Faculty of Sciences, has discovered an infallible method of ascertaining by the use of the telephone how much a given quantity of wine has been watered! The principle on which the invention rests is the variable conductivity of different liquids, notably of wine and water, the method of trial being apparently founded on Kohlrausch's test. The apparatus works as follows:—Two vessels, one containing wine known to be pure, the other the wine to be tested, are employed. The telephone is in connection with both liquids. If the sample of wine under observation is as pure as the standard used for comparison no sound is heard; if, on the contrary, it contains water, the tell-tale telephone "speaks," and the greater the proportion of water the louder the instrument complains. A dial on which a number of figures are marked is connected with the telephone. To ascertain the proportion of water in the wine tested, the operator moves a hand on the dial until the telephone relapses into silence. The hand has thus been brought to a certain figure on the dial, corresponding to which is found the exact proportion of water contained in the quantity of wine. M. Maneuvrier's invention can, he says, be easily applied to the testing of many other liquids, and even solids, which may be adulterated by the addition of foreign matter possessing a conductivity different to that of the original substance.

(*Continued on page* 227.)

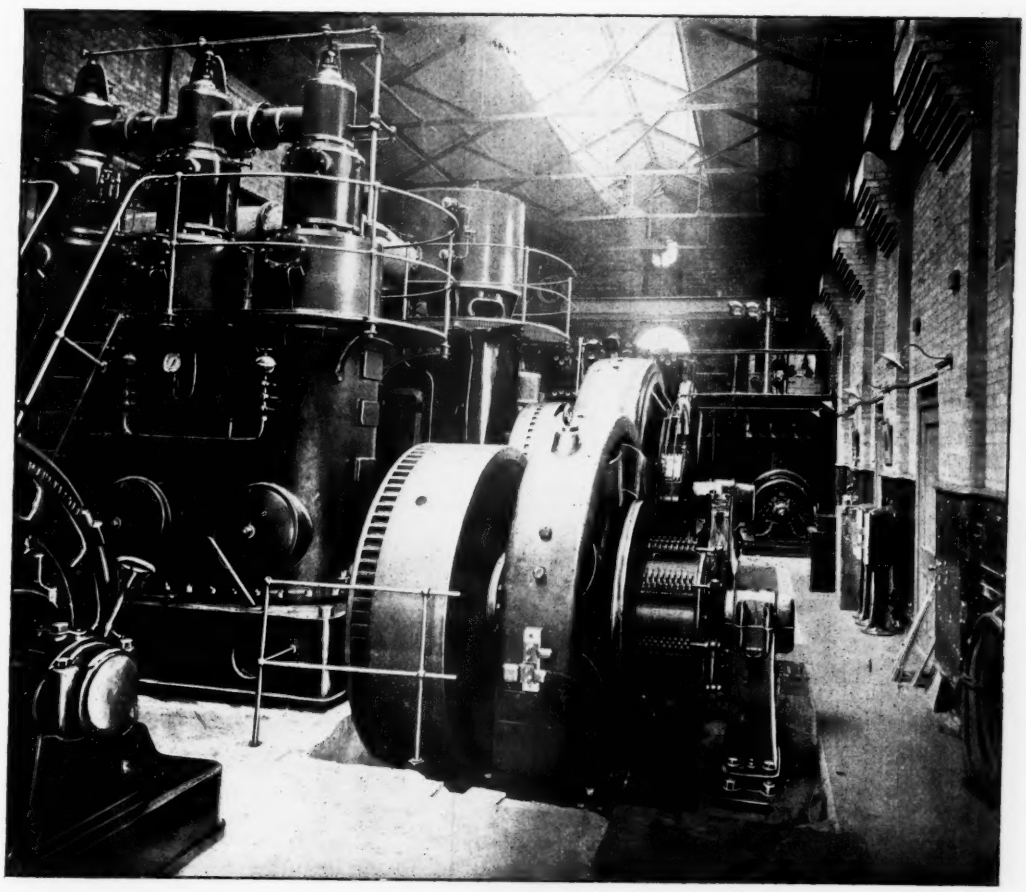
LOWESTOFT MUNICIPAL ELECTRICAL TRAMWAYS.

The opening of the Lowestoft electrical tramways adds one more to the many instances of public enterprise in the provision of up-to-date facilities for the local travelling public, and in this particular case, as in the neighbouring, and, to some extent, rival town of Yarmouth, there is little doubt but that, as time goes on, they will prove exceedingly popular, both with the residents and with visitors.

Local tramway history commenced in August, 1898, when the Town Council received a proposal from a syndicate for the construction of the East Anglian Light Railways, which would link together the towns of Caister, Great Yarmouth, Lowestoft and Southwold, and the Council agreed to support the application to the Light Railway Commissioners for sanction to construct the railway from Caister through Lowestoft to Kessingland, subject to a suitable agreement in regard to road maintenance being arrived at. Subsequent negotiations, however, led to a difference of opinion between the company and the Corporation, resulting in opposition by the latter, which was eventually withdrawn on the satisfactory arrangement of terms for the construction or purchase by the Council, and a subsequent lease to the company for a term of years. As the Board of Trade declined to entertain the incorporation of this agreement in the light railway order, further negotiations took place, ending in the Council obtaining powers and constructing and working the tramways itself, and the Council has further agreed to purchase the company's powers for the proposed line to Kessingland.

The route which was opened on July 22nd consists of one length running through the main street, from the northern boundary to the southern boundary, some $3\frac{3}{4}$ miles in length, which, if the extension to Kessingland is carried out, will be extended $3\frac{1}{2}$ miles further from the southern boundary. There is also a branch from the centre of the town route, up the Denmark Road, passing the railway station, and leading to the car depôt at the electricity and destructor works in Rotterdam Road.

The total route length is approximately $5\frac{1}{2}$ miles, of which $1\frac{1}{2}$ miles are double track, and the route is practically level throughout. Advantage was taken of the temporary upheaval of the streets to carry out various building improvements along the routes.

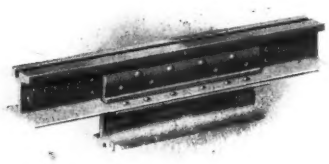


Interior of Engine House, Showing New Generators, Balancer and Traction Switchboard.

The contractors for the permanent way were Messrs. Wimpey & Co. For the track-work a gauge of 3 ft. 6 in. has been adopted, similar to that at Yarmouth; the rails, which are of the usual girder type, weigh 100 lbs. per yard and are in 60 ft. lengths. They were supplied by Messrs. Penny and Co., agents for the Société Anonyme de Marcinelle et Couillet, Charleroi, Belgium, the manufacturers. All the special work, junctions, points, crossings, &c., including those at the car-sheds, were supplied by Messrs. Hadfield's, Sheffield, and are made of their patent manganese steel, a specially hard and tough metal, the valuable properties of which have been recognised universally by tramway engineers. For the passing places and special junctions the

points are 12 ft. 3 in. long, and 100 ft. radius. The crossings are 8 ft. 6 in. long, angle 1 in 6, and the car-shed points are 6 ft. 6 in. long, with a radius of 42 ft.

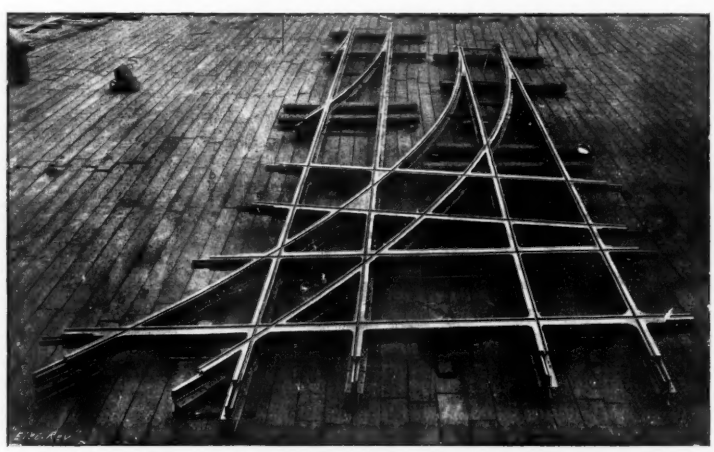
A special feature of the track-work is the Waveney Road Junction, and the London Road railway crossing—which were erected complete at Messrs. Hadfield's in the first instance. The bulk of the crossings are of the compound type, as many as three and five crossings being in one manganese steel casting; this arrangement produces an exceedingly rigid job, and diminishes the number of joints which would otherwise be required. Messrs. Cooper & Howard Smith's anchor and intermediate joints have been used throughout.



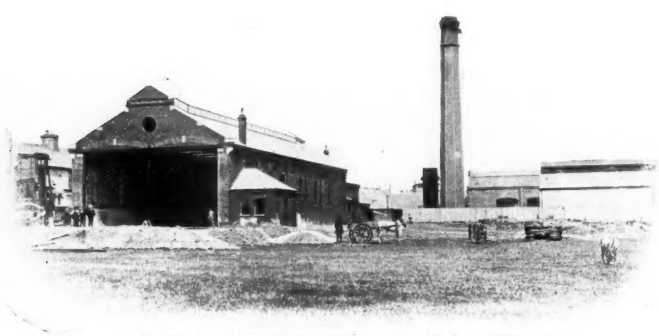
Cooper & Howard Smith's Anchor Joint.

The track has been electrically bonded with 0000 S.W.G. Columbia bonds, and is cross-bonded every 40 yds. The paving adopted consists of basaltic lava and granite blocks, laid on a bed of concrete 6 in. deep, and grouted in with bitumen and cement. Some 4,000 tons of basaltic lava blocks are used between the rails, and 800 tons of granite for the margins. The former material, like wood, is comparatively noiseless, and possesses non-slipping qualities.

The overhead construction has been carried out by Messrs. Robert W. Blackwell and Co., Ltd.



Special Track-work for the London Road Railway Crossing.



View of the Car-Shed and Generating Station.

The whole of the work is of the side bracket construction, the brackets themselves being of neat and substantial design. The attachments to trolley wire are of flexible suspension type, with double insulation of the well-known "Aetna" material throughout.

The poles are of the usual three-section type, two sizes being used; No. 1, 5 in., 6 in. and 7 in. diameter, and No. 2, 6 in., 7 in. and 8 in. The bracket arms vary in length from 10 ft. 6 in. to 18 ft., of $2\frac{3}{8}$ in. diameter steel tubing, and in common with the whole of the overhead material are of British manufacture.

The trolley wire is double throughout, of hard drawn copper ·372 in. in diameter or 000 S.W.G. Tensile strength 24 tons per square inch.

Generally the whole may be considered an example of first-class English construction.

The work calling for special note in connection with the system is no doubt the surmounting of the difficulties put upon the undertaking by reason of the swing bridge across the harbour, situated almost exactly in the centre of the town. The whole of the work on and in the neighbourhood of the swing bridge has been specially designed, and has had to meet with the approval of the Board of Trade as well as of the Great Eastern Railway Co., who control the bridge and harbour.

The special work applies both to the permanent way and to the electrical equipment. A shallow section of rail has been employed for the bridge, fixed to the ironwork of the bridge and electrically bonded thereto, and the greatest care has been taken to secure alignment of the bridge rails with the track on either side. In this connection a mechanical device is employed, interlocking with the hydraulic levers operating the bridge.

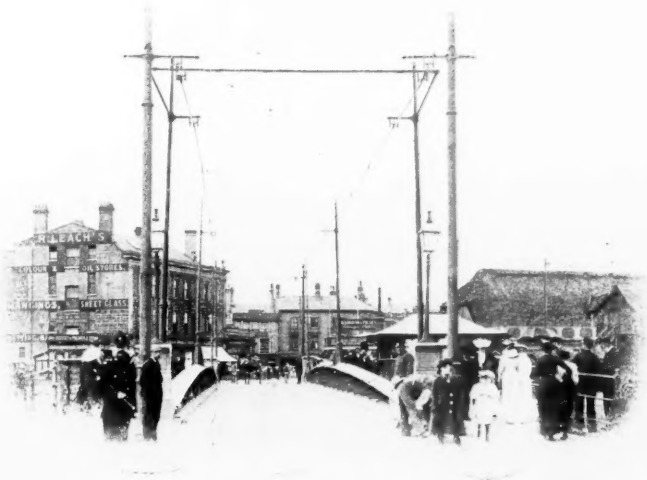
Considerable ingenuity has been displayed in the arrangement of the electrical connections on the swing bridge. The latter is about 40 ft. long, and is worked by hydraulic power. It is in constant use, especially during the fishing season, when a good deal of shipping is entering and leaving the harbour. In operation the bridge is tilted to clear the supporting wedges, and then rotated through a right angle on a pivot fixed about one-third from one end. In order to clear the rigging of boats the poles supporting the overhead conductors are placed some distance from the bridge, necessitating considerable overhanging on the equipment of the bridge itself. This has been accomplished by the use of aluminium conductors of T section, the overhanging end being supported by a light steel framework.

Specially designed contact pieces provide a continuous running surface over the bridge when it is closed, and in accordance with Board of Trade regulations, the power is automatically cut off from the conductors on the bridge as soon as it tilts to open. The current is at the same time cut off from the trolley wire some distance on each side of the bridge, the distance being so great that it is impossible for a car to reach the bridge by means of its own momentum when the bridge is open.

The contract for the feeder cables was placed with Messrs. Callender's Cable Co., who also supplied the cables under the lighting contract.

The traction feeders are lead-sheathed, of ·2, ·15 and ·1 sq. in. in section, the negative feeder being ·4 sq. in. in section. The majority of the feeders are drawn into stoneware ducts, laid in the centre of the track, and provided with manholes at suitable distances. The feeder cable which supplies the north end of the town follows a cross-

road from the generating station, and is laid on the solid system in creosoted wood troughing. The cables are led into section pillars, supplied by Messrs. Callender, from which the overhead line is fed at the usual half-mile sections. The cable work for maintaining the rail circuit under the harbour required special consideration, as it had been found that the original lighting cables laid in the mud



View of the Swing Bridge and Special Overhead Work.

at the bottom of the harbour were unreliable, owing to their sustaining mechanical injury through the movement of the shipping. This section of the work was eventually undertaken by Mr. G. A. Bruce, the resident electrical engineer, and the cables are drawn into a steel pipe, fitted internally with a wooden divider of star section, each cable lying in its own compartment, and so giving every facility for withdrawal and renewal when necessary. The cables are connected to a switch and test board on either side of the harbour.

Mr. Bruce is to be congratulated on having successfully "engineered" his scheme at a cost far below that of the lowest tenderer.

The contract for the rolling stock was placed with the British Westinghouse Co., two types of car being adopted. There are 11 double-deck and four single-deck cars, the trucks and bodies for which were supplied by Messrs. Milnes & Co., Hadley. The double-deck cars have a seating capacity of 48 passengers, 22 inside and 26 out; they are provided with sliding windows, twin doors, and reverse stairways. The trucks are of Milnes standard rigid wheel-base type, and the cars are fitted with both wheel, slipper and electrically-controlled brakes. The overall length is 33 ft. 6 in. and the greatest width 6 ft. 7 in. The single-deck cars are of the composite type, seating 38 passengers, 26 in the closed compartment and six in each of the end compartments. The closed compartment is arranged in the centre of the car, and is provided with reversible transverse seats; the end compartments are enclosed on one side by a fixed window and on the other by an ornamental wrought-iron grille. These cars are mounted on trucks of the Milnes maximum traction type, and, as in the double-deck cars, three types of brake are provided. In both types of car electric light and bells are installed, and destination indicators of the roller blind type are provided.

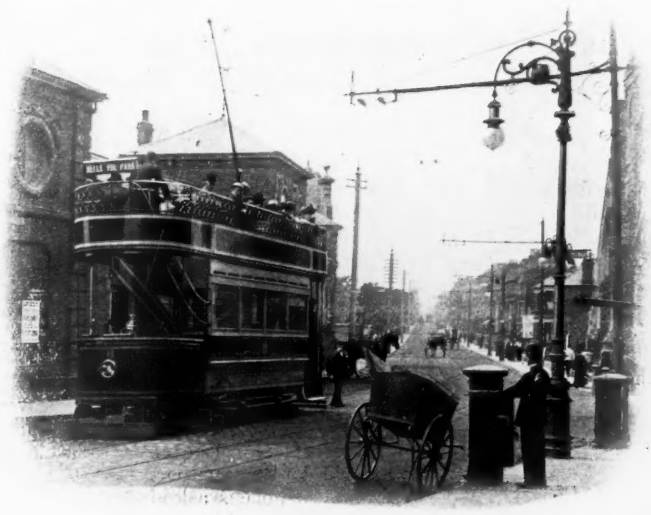
The electrical equipments are of the British Westinghouse Co.'s standard type, the controllers being of the series-parallel type with magnetic blow-out, and the motors having a normal output of 26 H.P., there being two on each car. Westinghouse canopy switches, lightning arresters, and automatic circuit-breakers are also provided. The cars are fitted with electric headlights, and enclosed trolley standards, Tidswell's life-guards and collapsible gates to the platforms.

An electrical track sweeper of Messrs. Brecknell, Munroe & Roger's make is also provided for scavenging the track.

The new car depôt adjoins the electricity and refuse destructor works in Rotterdam Road, and forms the present terminus of the Denmark Road route. The building is constructed in red brick with stone facings, and was erected by Mr. A. G. Beckett, of Oulton Broad, to the design of Mr. J. Roberts, of Lowestoft, architect under Mr. Hawtayne, the consulting engineer.

Accommodation is provided for 15 cars and the track sweeper. There are four tracks partly supported on pillars, with a view to providing facility for examination and repairs from underneath. Repairing shops, fitted with suitable machinery, and accommodation for the men are also provided. The car entrance to the sheds is provided with steel rolling doors.

The generating station, which the advent of the tramways has had the effect of completely filling, was opened in 1901, when some 225 KW. of plant was installed. At the present time this has been increased to 1,575 KW., or 1,900 KW. on emergency load.



View along the London Road South, Showing Type of Double-deck Four-Wheel Car.

The boiler house plant consists of four Babcock and Wilcox boilers, each capable of evaporating 5,600 lbs. of water per hour, and having a working pressure of 160 lbs. per square inch and one Musgrave dryback marine boiler (on order) capable of evaporating 12,500 lbs. of water per hour. Superheaters are provided on the large and two of the smaller boilers, capable of raising the temperature of the steam by 100° to 120.° Injectors are fitted to all the boilers, and one electrical and two steam pumps are provided for boiler-feeding purposes. A motor-driven Green economiser is also provided. A

Wheeler condenser of 400 H.P. is installed in conjunction with a Wheeler-Barnard fan-draught cooling tower, the fan being driven by a Westinghouse motor, and a further 1,000-H.P. condensing plant is being installed by Messrs. Bertrams, with a Klein forced-draught cooling tower.

The generating sets are of the high-speed enclosed type, by various makers, direct-coupled to compound-wound generators, each of which is provided with a switch for cutting out the series winding when used on the lighting circuits.

The plant consists of one 75-KW. generator coupled to a Musgrave engine, running at 400 revolutions per minute; one 150-KW. generator, with Musgrave engine, running at 330 revolutions per minute; one 250-KW. generator, with Browett-Lindley engine, running at 350 revolutions per minute; one 550-KW. generator coupled to a Willans compound three-crank engine running at 230 revolutions per minute; and a similar sized generator coupled to a Browett-Lindley two-crank compound engine running at 230 revolutions per minute.

The two sets last named are the latest additions to the station. The Willans engine is their 3 T size, rated at about 730 B.H.P., the high-pressure cylinders being 18·9 in. and the low-pressure 32·3 in. in diameter, with a stroke of 13·4 in. The Browett-Lindley engine has cylinders (high pressure) 22¼ in. and (low pressure) 36 in. in diameter, with a stroke of 18 in., the engine being fitted with an auto-expansion governor, and on test gave a steam consumption of 24·2 lbs. steam per kilowatt-hour, full load, condensing; 25 lbs. at ¾-load and 27·3 lbs. at ½-load. The generators for these sets are by the B.T.H. Co., and the smaller one will eventually be replaced by one similar to the larger machine, having eight poles, and a slot-wound armature mounted on a cast-iron spider.

The original lighting switchboard and the new panels, two being generator panels, and the remainder for controlling the balancer, occupy a gallery at the end of the station. On an extension at the side is mounted the traction board, which consists of white marble panels; one contains throw-over and equalising switches, three are feeder panels, provided with ammeters, circuit breakers and single-pole Q.B. switches, one is a load panel with ammeters and voltmeters of the Weston type, and the usual Board of Trade panel completes the board.

The original set of balancers and boosters, consisting of four machines coupled, of 18 KW. capacity, was supplied by the British Thomson-Houston Co.; this has been supplemented by a further set, supplied by the British Westinghouse Co., consisting of two outer 40-KW. and one central 80-KW. multipolar machines mounted on the same spindle, and running at 800 r.p.m.

This machine can be used (1) as a motor balancer, with the central machine across the outers, and the end machines across the three-wire system; (2) with the central machine cut out and the end machines as motor and generator according to balance; (3) the outer machines running on the three-wire system as motors, and driving the central machine as a generator for traction purposes at light loads; (4) the reverse of the previous arrangement—at periods of light load in the lighting department; (5) similar to No. 3, with the central machine feeding the traction side in parallel with a small traction generator, not capable of overloads; (6) the reverse of the previous operation—the outer machines being generators, and balancing and feeding into the lighting system. Both the motor balancers are controlled from the lighting switchboard.

Some idea of the enterprise shown in carrying out the scheme may be formed when it is borne in mind that a commencement was not made till March 11th, 1903, the whole of the work, excepting a few details, being completed by the end of June.

The official inspection of the electrical equipment was made on July 16th and of the track on July 21st, the Board of Trade expressing their complete approval of all the arrangements.

In both the sub-committee and the general committee a good start was made by the chairman, Mr. L. F. Orde, who happens to be mayor this year. He has devoted a considerable amount of time, both to the technical points and to the general details, and has done an immense amount for the municipal undertaking.

The whole of the contracts for the tramways and street widenings have been executed under the supervision of Mr. W. C. C. Hawtayne, the consulting engineer, Mr. W. Beer looking after the permanent way design, and Mr. B. S. Aldis being clerk of the works. For Messrs. Wimpey & Co., the contractors for the permanent way, Mr. J. F. Tyler acted as resident engineer, and Mr. J. A. Bruce, the borough electrical engineer, represented the Lowestoft Corporation.

FIG. 1. FIG. 2.

ELECTRICAL SAFETY DRESS.

AN ELECTRICAL SAFETY DRESS.

NIKOLAUS ARTEMIEFF, a Russian professor, has invented a safety dress to protect workmen and others from death or injury in case of accidental contact with high-tension circuits. The dress is made of a fine pliable woven metal fabric, made up into a garment which covers the whole body—head, hands and feet. To give it greater strength, the metal fabric is worked on to a linen backing or lining. The dress is so designed that the wearer can put it on above his ordinary dress without assistance. The metal fabric in front of the face and on the hands does not seriously interfere with the seeing and handling of objects.

The protective action of the dress is due to the fact that it short circuits the body of the wearer. When the dress is on, no dangerous potential difference can arise between any two points of the body. The resistance of the dress is less than 0·01 ohm, while the resistance of the human body is greater than 2,000 ohms, these resistances being measured in both cases from hand to hand. With a current of 1,000 amperes flowing through the dress from hand to hand, the shunt current flowing through the body would amount to only 0·005 ampere—a current which would be quite harmless.

The dress, however, will not carry a current of 1,000 amperes without undue heating. It is only capable of carrying a permanent current of 200 amperes, or a current of 600 amperes for a few seconds.

The dress also prevents a static charge from injuring the body. With the dress on, a man may touch any part to a

high-pressure installation; but if the insulation of the high-pressure circuit should happen to be defective, it can only be touched with safety when the man is himself well insulated, say by standing on a sheet of vulcanite, or on a board supported on porcelain insulators. Experiments have been carried out successfully with pressures up to 200,000 volts.

There is, however, under certain circumstances, a risk of injury by burns, when, for example, a high-pressure circuit through the dress is broken by the removal of one hand from the conductor. Under these circumstances an arc may be formed, the excessive heat of which may burn the underlying skin. But in the great majority of cases which arise in practice the workman is completely protected.

The Artemieff safety dress is manufactured and sold by Messrs. Siemens & Halske, in three different sizes.

Fig. 1 shows the safety dress worn over the ordinary dress, ready for use. Fig. 2 shows Prof. Artemieff in his safety dress, in the circuit of an alternating current transformer of 20 KW., with a pressure of 150,000 volts, 50 periods. In fig. 2 a stream of sparks goes direct from pole to pole, and another stream of sparks goes from one pole over the safety dress to the other pole.

The Artemieff safety dress appears to have been thoroughly tested by its inventor, and if it does not interfere too much with the movements of the workman, it will be very valuable for the protection of life. The ordinary precautions, such as rubber gloves and shoes, are very unreliable when dealing with extremely high pressures, such as are now used for long-distance transmission.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 222.)

Australian Telegraphs.—Reuter's Melbourne agent says that the House of Representatives of the Commonwealth has ratified the agreement with the Eastern Extension Co.

Liverpool.—Mr. Charles McArthur, M.P., has received a letter from Mr. Austen Chamberlain, M.P., Postmaster-General, stating that the trunk telephone service between Liverpool and the manufacturing districts of Lancashire and Yorkshire, about which Mr. McArthur wrote on July 13th, will be greatly improved by the opening of additional circuits between Liverpool and Wigan, Accrington, Bolton, Burnley, Oldham, Rochdale, St. Helens, and Huddersfield. Five additional circuits are being provided between Liverpool and Manchester. These are being carried by means of an underground line through Warrington, and are being pushed forward as rapidly as possible. Other wires between Liverpool and the districts named will also be provided.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 30, 1899	
Trinidad-Demerara No. 1	Aug. 27, 1901	
Dominica-Martinique	May 8, 1902	
St. Lucia-Martinique	May 8, 1902	
Guadeloupe-Martinique	May 9, 1902	
Martinique-Puerto Plata	July 10, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-St. Vincent	Sept. 19, 1902	
Reissa-Issa	Oct. 22, 1902	
Reissa-Yemani	Oct. 22, 1902	
Paramaribo-Cayenne	Feb. 27, 1903	
New York-Haiti	April 13, 1903	
Siteebondo-Bandjermasin	July 6, 1903	Aug. 1, 1903
Zanzibar-Mombassa	July 16, 1903	July 3, 1903
Perim-Assab	July 27, 1903	July 30, 1903
Fao-Bushire	July 28, 1903	
Bolama-Bissao	Aug. 4, 1903	
St. Jacques-Haiphong	Aug. 3, 1903	
Landlines.		
U.S. of Colombia:—Landlines to Dagua	July 14, 1903	
To Puerto Barrios	July 28, 1903	

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—August 17th. Tenders are being invited by the Provincial Government Authorities in Liège for the concession for the construction and working of an electric tramway on the overhead conductor system between Liège-Guillemins and the village of Angleur. Particulars may be obtained from, and tenders are to be sent to, Le Gouvernement Provincial, Liège.

Bexley.—August 21st. Street lamps and fittings for the U.D.C. See "Official Notices" to-day.

Brighton.—August 10th. Electricity meters for one year. See "Official Notices" July 24th.

France.—August 11th. The French Ministry of the Colonies, in Paris, is inviting tenders for the supply of 60 tons of annealed and galvanised iron wire required in connection with the telegraph service in Indo-China. Particulars may be obtained from, and tenders are to be sent to, Le Ministère des Colonies, Rue Jean Nicot 4 bis, Paris.

France.—August 13th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 170,000 porcelain insulators. Tenders are to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle 103, Paris, whence particulars may be obtained.

Germany.—Tenders are at present being invited by the Municipal Authorities of Tubingen for the supply of a new steam engine and dynamo for the municipal central electric lighting station, at an estimated cost of £2,500.

The Municipal Authorities of Riesenburg, Western Prussia, are inviting tenders for the establishment of a central electric lighting station in the town.

Grimsby.—The Corporation wants tenders for a motor balancer and switchboard, and underfeed stokers to four boilers. See "Official Notices" to-day.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Holland.—October 1st. Tenders are being invited by the municipal authorities of Utrecht for the construction and equipment of a central electricity station for lighting and power purposes, and for the working of a tramway.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Beszterczebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

Leeds.—August 7th. Messrs. Graham, Morton & Co., Ltd., want tenders for the necessary electric cables, fittings, &c., for their new works. See "Official Notices" July 17th.

London.—August 11th. Low tension feeder switchboards for the tramways sub-stations in Camberwell and New Cross. See "Official Notices" July 10th.

London.—October 6th. Four 5,000-H.P. vertical-horizontal steam engines, each suitable for driving a three-phase generator, for the Greenwich power station. See "Official Notices" July 24th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Northampton.—August 15th. Steam dynamos, battery, switchboard, equipment of trolley lines, feeders, cars, permanent way, buildings, car-sheds, piping, condenser, &c., for tramways power station. See "Official Notices" July 31st.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

Rochdale.—August 10th. Sixteen double-deck double-truck, 20 double-deck single, and 5 single-deck combination cars. See "Official Notices" July 24th.

Swindon.—August 26th. Rails, permanent way, and paving for Corporation tramways. See "Official Notices" July 31st.

West Ham.—August 21st. Traction switchboard, booster, &c. See "Official Notices" July 31st.

CLOSED.

Derby.—The tender of the Lancashire Dynamo & Motor Co., Ltd., has been accepted for two sets of balancers, one set of reversible boosters for lighting, and one set of automatic reversible boosters for traction.

Gloucester.—At a recent meeting of the Tramways Committee of the T.C., the tender of Messrs. J. Byard & Son was accepted for converting and enlarging the Bristol Road stables, &c., into a depôt for electrical cars. It was also agreed to enter into the following contracts for that portion of the tramway which is outside the city and in the County Council's area :—

Sections E (rails and accessories) and F (construction of permanent way), Mr. George Law, Kidderminster, for the sum of £8,450.

Section H (poles), Messrs. J. G. White & Co., Ltd., for the sum of £829 5s.

Section G (cables, troughs, and feeder pillars), substituting Callender's vulcanised bitumen cables for lead-sheathed cables, the British Electric Equipment Co., for the sum of £2,480.

Sections I (overhead line material and rail bonds) and J (erection of poles and overhead equipment), the British Electric Equipment Co., at the same schedule of prices as applies to the city.

The Committee recommended the Council to approve of the County Council entering into the contracts recommended by Messrs. Dickinson & Co.

Kingston-on-Thames.—The T.C. has accepted the tender of Messrs. Bennis & Co., Ltd., for the supply of a mechanical stoker fitted with patent pneumatic gear and self-cleaning compressed air furnaces to the electricity works, at £107 10s., and that of the Wheeler Condenser and Engineering Co., for a horizontal combined air and circulating pump, inclusive of suction and delivery pipes and valves, at £130.

Leicester.—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., of Preston, for the supply of 58 tramcars at £510 each.

Lincolnshire.—The County Council has accepted the tenders of the following for supplies of electric lighting plant for the Bracebridge Asylum:—The Chloride Electric Storage Co., Ltd., Clifton, Manchester, for a storage battery, at £459; Messrs. W. Foster & Co., Ltd., for two engines and dynamos, motor-generator, main switchboard, meters, &c., at £1,211; Mr. H. T. Hazzledine, Lincoln, for electric wires, switchboard, &c., at £2,250.

Wolverhampton.—The T.C. has accepted the tender, amounting to £2,891, of Messrs. Callender's Cable & Construction Co., Ltd., of London, for the supply and laying of tramway feeder cables on the Wednesfield, Dudley, and Willenhall Roads.

NOTES.

Determining the Moment of Inertia of the Armature of a Dynamo.—The moment of inertia of the armature of a dynamo is an important factor in connection with many calculations, especially in determining the friction of the bearings and brushes and the resistance of the air, by observing the spontaneous retardation of the armature when left to itself. Now, calculating the above factor from the dimensions and materials of the rotating parts is both troublesome and inaccurate. Ch. Fabry, in an article recently published in *L'Eclairage Electrique*, therefore suggests a novel method, based on observing the spontaneous retardation of the armature, with the exciting current kept on. During the retardation, there acts on the armature a couple variable with the speed and due to friction and the waste of energy in the iron. A preliminary experiment will give the value of this couple in terms of the speed; it is sufficient to allow the motor to run without load and to measure the armature currents for different speeds. A direct-current dynamo being given, which is made to work as a motor; let, therefore, the exciting current be kept on. The motor is allowed to run without load, until a constant speed is reached, when both the angular velocity ω, and the armature current i, are measured. Varying the voltage at the brushes, the same measurement may be repeated for different values of the speed, and a table prepared or a curve drawn, giving i in terms of ω. For one value of the speed ω, the pressure at the brushes E having finally been measured, the back-electromotive force will be given by the formula

$$e = \text{E} - r\,i$$

where r is the resistance of the armature, the term $r\,i$ often being negligible. As e is proportional to ω,

$$e = a\,\omega,$$

a being a given constant. All the elements necessary to calculate the retarding couple in terms of the speed are thus given; the power spent in the armature, apart from the joule effect, at a speed ω, will be

$$\text{W} = e\,i = a\,\omega\,i,$$

the corresponding couple being

$$\text{C} = \frac{\text{W}}{\omega} = a\,i.$$

Under these conditions, let the motor be driven at a convenient speed and, the exciting current being kept on, let the armature current be broken, when the retardation will be observed. T being the time required in passing from the speed Ω to the speed 0, and K being the moment of inertia, the waste of energy in this part of the experiment is the same as with the above experiments; for the speed ω, the retarding couple accordingly has the same value as above calculated, viz., $\text{C} = a\,i$. The equation of motion therefore is

$$-\,\text{K}\frac{d\,\omega}{d\,t} = a\,i,$$

where a is a given constant, and i the current, which, with the motor running without load, would correspond to the speed ω, *i.e.*, is a known function of ω. From the above is derived

$$\text{T} = \frac{\text{K}}{a}\int_0^{\Omega}\frac{d\,\omega}{i}.$$

The curve having the values of ω as abscissæ, and those of $\frac{1}{i}$ as ordinates may be drawn, and its area measured by means of the planimeter, when the above equation will furnish the value of K. If, as frequently is the case, i may be considered as a practically linear function of ω, no graphical construction will be required, an equation of the form

$$\text{T} = \frac{\text{K}}{a\,m}\log.\frac{(m\,\Omega + i_0)}{i_0} = \frac{\text{K}}{a\,m}\log.\frac{\text{I}}{i_0}$$

being easily deduced. The same method may be used in determining the moment of inertia of any apparatus coupled to the armature.

Mechanical Engineers' Conference.—The annual summer conference of the Institution of Mechanical Engineers was concluded on 29th ult. at the Philosophical Hall, Leeds. During the meeting papers have been read by Mr. H. Ade Clark, of Leeds, on "The Diesel Engine," who pointed out the advantages of this type of engine in cheap cost of working, especially in smaller sizes. Mr. H. H. Suplee, of New York, read a paper on "Fast Cutting Tools." Prof. H. S. Hele-Shaw, of Liverpool, read a paper on "A New Form of Friction Clutch." Prof. Shaw pointed out that there were four conditions desirable in the friction clutch, namely:—(1) It must have sufficient gripping power. (2) Undue wearing of the surfaces must be avoided. (3) Provision must be made for conveying away the heat where there is much slipping contact in the clutch. (4) Motion should be imparted to the driven shaft without shock. The Professor then gave details about other types of clutches, and went on to describe in some detail the theory involved in the new friction clutch. Here the gradual increase of speed was brought about by compressing corrugated discs of metal, which were placed in a box of the type of the Weston coupling, so that the plates in expanding alternately engaged with two sleeves, one connected with the driving piece of machinery, and the other with the driven piece. After showing various elaborations of the friction clutch, Prof. Hele-Shaw pointed out one or two applications to which it had been put, including that of a motor-car. He concluded his paper by describing the experiments to which a clutch with plates only 6 in. in diameter had been put. When substituted for the cone clutch of a 24-H.P. Darracq car, there was a remarkable improvement in action.

Mr. Henry McLaren, Leeds, gave a paper on "Economy of Fuel in Electric Generating Stations," based on the yearly returns of municipal lighting authorities to the Board of Trade. The first point that attracted attention, said Mr. McLaren, was the great difference in cost per unit generated in those stations. Some were condensing, others partly condensing, or non-condensing stations, the price paid for coal varied largely, and different systems of supply were used, all these considerations affecting the cost. In dealing with various sub-divisions of stations, Mr. McLaren considered four provincial stations generating energy for electric tramways, all condensing. It was surprising to find, he said, that at least two of the lighting stations, Leeds and Edinburgh, delivered electrical energy at the consumers' meters at 9 per cent. lower average cost than those four power stations averaged at their switchboards; moreover, Edinburgh was a non-condensing station. Glasgow, the most economical of the four power houses, with an annual output of over 10,000,000 units, and a tramway load factor, delivered energy at the switchboard at a cost of 0·6d. per unit works costs, whereas Leeds lighting station, with only 3,000,000 output and a lighting load-factor showed a works cost of 0·62d. per unit, including the heavy loss in the mains. If the Leeds energy was metered at the switchboard the works costs would read considerably lower than Glasgow, the most economical power house in the country. In the case of two metropolitan and one provincial power houses, generating energy for electric railways, these are beaten in economy by the tramway power houses by over 20 per cent. in works costs, and 5¾ per cent. in fuel costs. In a diagram indicating the average costs of the various classes of stations or power houses, it was seen that Leeds lighting station, with fuel costs of 0·27d. per unit, or works cost of 0·62d., was considerably lower than the average of the tramway power stations. The metropolitan condensing stations after allowing 30 per cent. for outside losses and banking fires, &c., were using at least twice the amount of fuel that economical plants ought to require. They generated during the year over 41,000,000 units, at a cost for fuel of over £200,000. A large percentage of this amount could have been saved by the use of well-managed, economical generating plant. Taking the average station throughout the country, there was great room for improvement; on the other hand, one found a few stations that left nothing to be desired, and some remarkably economical results were recorded, even in small provincial stations. Coal to the value of £839,613 was used in the 177 stations under review, and it was safe to assume that £100,000 was lost in engine leakages only. Generally, however, the costs in various stations throughout the country showed a decided tendency to improvement. This was partly owing to cheaper coal, but there was also a healthy rivalry between station engineers, and this should in time bring the electric generating stations into the front rank as regards economy of fuel.

In the evening the Lord Mayor (Mr. John Ward) and the Lady Mayoress held a brilliant reception at the City Art Gallery.

Somewhat at Sea.—Our valued contemporary, the *Scientific American*, whose pages are always interesting, is, unfortunately, rather weak on submarine telegraph cables. Not very long ago we noticed a reference to Siemens & Halske's lead-covered

submarine cables, which, however, were not intended for deep-sea cables, as our contemporary supposed! In the last number of our scientific friend we find the following in connection with a description of Heart's Content cable terminal:—"The cables are laid to the operating room through an underground conduit which is walled with masonry. The shore section and that which extends into shallow water is considerably smaller than the deep-sea cable, as it requires less protection. The one which was last laid consists of 18 strands, each strand composed of seven iron wires forming a metallic sheath for the copper wires which convey the electric current. The copper is embedded in gutta-percha incased in hemp which is saturated with a combination consisting principally of beeswax, paraffin and oil; this casing is surrounded by the iron wire, which is also covered with a waterproof compound. Several coatings of the hemp covering are wound about the gutta-percha, so that the copper wires of the deep-sea cable are really protected by five wrappings. The shore section differs from the deep-sea principally in the absence of the wiring on the outside." Surely, although the manufacture of submarine cables is not one of America's industries, our contemporary knows that the shore end is the heavy cable?

Continuous Working.—It has been advocated in America that if the eight hours' day is to be a success there should be three shifts of men every 24 hours, and capital would then be able to reap larger profits. If every works to-day ventured on this system, there would obviously not be men enough to go round; or if the present staff were divided into three shifts only two-thirds of the factory could be run without over-production. In the suggestion there is a strong colour of the all-importance of mere money-making, and no thought to the human side of the question. Dollars and the getting of them dominates everything, even to the sop thrown to the worker, who is promised that it will turn out so much to his benefit; also, logically carried out, there would be three shifts, we presume, in offices; and, finally, three distinct worlds, with a few particularly busy money-grubbers making business in all three worlds.

New Journal.—A remarkable innovation has been brought forward by the enterprising firm of Messrs. R. J. Nicholson and Co. (one of whose booklets we reviewed some time ago) in the shape of a monthly magazine styled "Everyday Electricity," price 2d. This is a non-technical journal devoted to the domestic and industrial applications of electricity, and is combined with a free information bureau, whence any six months' subscriber can obtain replies to inquiries relating to the cost of installation, consumption, &c., of electricity. A variety of subjects is dealt with in the first number, including wiring specifications, motors, cheap electric light installations, the new art fittings, &c., and other matters. The new departure is distinctly interesting in every sense, and we have no doubt that it will attain some degree of popularity.

Northampton Institute.—This Institute announces that its engineering day courses will commence on October 5th, and the entrance examination will be held on September 5th and October 1st. The courses in mechanical and electrical engineering include periods spent in commercial workshops, and are counted as preparation for the degree of B.Sc. in Engineering of London University.

The Edison Cell.—According to the daily Press, Mr. Edison has now brought his storage cell to the practical stage, and expects to be manufacturing the batteries in large quantities by the end of the year. He is now searching for a strong and durable running gear and framework for the new electric automobile.

"A motor-car propelled by the new battery was recently subjected to the severest tests. It was run over the roughest possible roads, until it had covered 5,000 miles. The batteries were then examined and found in excellent condition. Mr. Edison says: 'To judge from this test, the life of the battery seems to be practically limitless.'"

We sincerely trust that his most sanguine expectations will be fulfilled, for a really good automobile cell would be a godsend to the public, as well as to the electricity supply business. We have strong reason to believe that the Edison cell is an exceedingly good one for this purpose.

It is stated that Mr. Edison has become half-blind through persisting in experiments with the X rays. Both his eyes are out of focus, and his physicians have compelled him to discontinue his experiments, as total blindness is threatened. Already his assistant's right arm has become paralysed, and has had to be amputated owing to the tissues dying after exposure to the rays. The other arm was gravely affected, and three fingers had to be amputated. The surgeons say that Mr. Edison's escape from a similar fate to his assistant's is most remarkable.

Personal.—We understand that Mr. F. J. Platt, of Messrs. Fielding & Platt, Atlas Ironworks, Gloucester, is severing his active connection with the firm, although he will still retain his interest therein. He has succeeded the late Mr. J. D. Humpidge, to whose tragic end by the bursting of a fly-wheel we alluded some weeks ago, as one of the managing directors of the Dudbridge Ironworks, Stroud.

Mr. Henry Percy Maybury has been recommended for the appointment of resident electrical engineer to the Malvern E.L. and destructor scheme.

Sir William Preece, who is suffering from pneumonia and pericarditis, was reported last week end to be in a grave condition, but later news, we are glad to say, points to his speedy recovery.

The salary of the electrical engineer of Willesden (Mr. Murray) has been increased from £400 to £600 a year.

Electricity in Mines.—Experiments have been in progress lately to determine the merits of a new protection for cables in mines. According to the *Colliery Manager* this consists of insulating fibre and para rubber friction tape wound spirally into a tube, two strips being wound in opposite directions, so that their edges cross and cover up any openings. Outside the tube so formed a continuous jacket is woven, of cotton, similar to that on the outside of garden hose, not braided. The result is that a strong and durable, but flexible, tube is formed. The tube is saturated with an insulating material, care being taken that this does not touch the inside fibre, leaving the inside of the tube smooth and hard. The outside of the tube is then drawn through powdered mica, the final product being a tube which is very flexible and waterproof, and which resists considerable temperatures. Samples of cables were submitted to Prof. Arch. C. Elliott, D.Sc, Professor of Engineering in the University College at Cardiff. Two sets of tests were made, arranged to represent as closely as possible the conditions actually ruling in a mine, when rocks fall upon cables, and the object sought for was to see at what pressure the insulating material gave way and allowed connection to be made with "earth." Unarmoured cables were first tested without any other protection than their own insulation, and afterwards when enclosed in one of the "flexible conduits." With unarmoured cable, the force required to produce connection between the testing machine with simple compression and the copper conductor of the cable ranged from 0·372 of a ton per linear inch to 0·975, while when the cable was enclosed inside a "flexible conduit" the force required was from 2·5 tons to 6·2 tons, and that required for forcing the armour of an armoured cable through its insulating envelope on to the copper conductor was from 0·585 ton up to 0·081 ton. The above test corresponded to the fall of a mass of rock practically horizontally on to a pair of cables. With the indentation test, in which a cutting edge of 90° was used, pressure being employed to drive the sharp edge of the tool through the insulating material, or to drive the armour through, the figures were, with unarmoured cables, from 0·265 ton per inch to 0·370. For the cables enclosed in "flexible conduit" from 0·911 ton per inch to 1·223. With armoured cables the figures were from 0·422 ton per inch to 1·027. The "flexible conduit" has been used for some time in America for the protection of cables. It is obtainable from the American Circular Loom Co., 27, Chancery Lane, W.C.

Junior Institution of Engineers.—The summer meeting of this Institution, of which Col. E. Raban, C.B., Director of Works for the Navy, is President, is to be held at Sheffield. The proceedings will be opened by the Lord Mayor, the Rt. Hon. J. Wycliffe Wilson, J.P., on August 17th, who will receive the members at the Town Hall. Messrs. Davy Bros' works will then be visited, and afterwards those of Messrs. Hadfield's Steel Foundry Co., at Tinsley. On Tuesday there will be an excursion to Haddon Hall and Chatsworth. Messrs. Charles Cammell & Co.'s works will be visited on Wednesday morning, and in the afternoon Messrs. J. Dixon & Sons'. Thursday will be occupied by an excursion to Castleton, and on Friday are to be seen the Toledo Steel Works of Messrs. J. H. Andrew & Co. and the Suffolk Works of Messrs. T. Turner & Sons. The summer dinner takes place in the evening at the Royal Victoria Hotel, Sheffield. Mr. Ernest King, Messrs. Mellowes & Co., Corporation Street, Sheffield, is acting as honorary local secretary. The programme includes various hospitable invitations arranged for the entertainment of the members during the week.

"Science Abstracts."—The Council of the Institution of Electrical Engineers has now, with the approval of the Physical Society, undertaken the publication of *Science Abstracts* as an Institution publication. In connection with this work, Mr. Louis H. Walter, M.A., A.M.I.E.E., has been appointed editorial assistant to the secretary, and will take up his duties in the autumn.

Marriage.—On July 25th at St. Andrew's Church, Madras, by the Rev. I. N. Ogilvie, Presidency Senior Chaplain of the Church of Scotland, William Thom, M.I.E.E., general manager of the Madras Electric Tramways, was married to Clementine Winnie, youngest daughter of the late C. T. Marzetti, of Bromley, Kent.—(By cable.)

Appointments Vacant.—Borough of Ipswich, chief assistant engineer (£160), three charge engineers (£90), and two switchboard attendants; Belfast, chief lecturer in physics and electrical engineering, £350; St. George's Union, London, charge engineer. See "Official Notices" to-day.

Resistance of Fly-wheels.—A note in the *Scientific American* draws attention to the experiments of Herr Scholter, manager of the Nuremberg—Furth tramways, on the resistance of fly-wheels to rotation. This resistance may be divided into that exerted by the friction of the air against the rim, and that due to the displacement of the air by the arms; the latter is by far the more important of the two. In the central station of the tramway there are two horizontal tandem compound engines developing 450 H.P. at a speed of 95 revolutions per minute. Each has a strong fly-wheel whose arms are formed of a double T, with a central web set parallel to the centre line of the shaft. The suggestion was made to cover the two faces with a smooth protection of sheet metal, and this was done. In order to determine the difference in the resistance under the two conditions, with and without the covering, one dynamo was made to serve as a motor to drive the unloaded engine. With the fly-wheel in its original condition, the power required was 13,300 watts, while, after the wheel was covered, only 9,874 watts were needed—a difference of 3,426 watts, or about 5·7 H.P. As the loss is incurred all the time the engine is running, and as the average load on the engine is probably only about 300 H., the loss amounts to about 2 per cent. of the mean load—no inconsiderable

item—while the cost of covering the fly-wheels is an insignificant amount. As long ago as 1888 Prof. Brauer, of Darmstadt, called attention to the advisability of filling in the space between the arms of fly-wheels, and cited an experiment made by Inglis on a 630-H.P. engine, in which indicator cards showed a saving of 30 H.P., or 4·8 per cent., due to a reduction of fly-wheel resistance.

Electric Mine Locomotives.—The *Colliery Manager* last month reproduced a paper read by Mr. W. B. Clarke before the American Institute of Mining Engineers, on a new cable-reel device to allow locomotives to gather cars from rooms without a trolley wire. The device is rendered necessary in order to extend the scope of the electric locomotive. Storage batteries of the type at present available are unsatisfactory in mining locomotives, and the want of ability to depart in the least from the trolley line has been found very inconvenient.

The reel in question is mounted on the locomotive, and carries a considerable length of insulated cable, one end of which is connected to the trolley wire when the cable is in use, the other end being connected through a rubbing contact at the centre of the reel with the controller. As the locomotive runs along, the cable is unwound, the friction of the working parts maintaining a constant tension on the cable so as to prevent kinking. The moment the direction of running of the locomotive is reversed a mechanical device automatically comes into action whereby the cable is wound up on the reel. In order to ensure that the cable shall always be in tension, the reel is driven by a friction clutch, which tends to wind up the cable faster than the locomotive travels. Thus, while the cable is being wound up there is always slipping between the rubbing surfaces, maintaining a tension of 30 lbs. on the cable, so so that it cannot be run over or kinked.

In the same paper there is mentioned an installation in America having a plant capacity of no less than 2,900 KW., distributed amongst eight engine rooms, 75 miles of underground trolley wires, and 44 mine locos. of 4,400 H.P. in all. In another case power is transmitted at 5,600 volts, three-phase, 25 cycles per second, from a generating station at bank to a sub-station in the mine 9,000 ft. distant, where it is converted to direct current at 275 volts. The generating plant consists of two 150-KW. G.E. double-current generators, supplying direct current to the outer end of the haulage circuit and alternating current to step-up transformers for the high-pressure lines. The cables are three-core rubber-insulated and lead-covered, laid in the return-airway parallel to the main heading. A 300-KW. alternator has recently been added, generating direct at 5,600 volts.

NEW COMPANIES REGISTERED.

Nottingham Electrical Co., Ltd. (78,168).—This company was registered on July 28th, with a capital of £1,000 in £1 shares, to carry on the business of electricians, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in all apparatus and things for the generation, supply, distribution, accumulation and employment of electricity, electrical and general engineers, tool makers, machinists, contractors, &c. The first subscribers (each with one share) are:—J. Simmonds, 15, Chaworth Road, West Bridgford, Nottingham, cashier; Mrs. A. H. Weeds, 5, Park Avenue, West Bridgford, Nottingham; Mrs. E. Hughes, 10, Cramer Street, Nottingham; H. K. Hughes, 10, Cramer Street, West Bridgford, Nottingham; H. Weeds, 5, Park Avenue, West Bridgford, Nottingham, ironmonger; Mrs. M. A. Simmonds, 15, Chaworth Road, West Bridgford, Nottingham; and W. W. Wiggins, 79, Clapton Road, Nottingham, electrical engineer. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £20. Registered office, 13, Farmer's Factory, Sherwood Street, Nottingham.

North Wales Power and Traction Co., Ltd. (78,193).—This company was registered on July 30th, with a capital of £270,000 in £5 shares, to enter into contracts (1) with Bruce Peebles & Co., Ltd., (2) with the Northern Counties Traction Co., Ltd., (3) with J. Tomkinson, M.P., and Col. H. Platt, C.B., and (4) with the Portmadoc, Beddgelert and South Snowdon Railway Co; and to carry on the business of electricians, electrical, mechanical and general engineers, suppliers of light, heat and power by electricity, galvanism, magnetism, gas, water or otherwise, owners of tramways, railways, motor cars and other means of transport, &c. The first subscribers are:—J. Tomkinson, Willington Hall, Tarporley, Ches., M.P., 100 shares; J. E. Rawlins, Syston Court, near Bristol, gentleman, 100 shares; A. Deedes, Frenchay Manor, near Bristol, M. Inst. Bankers, 100 shares; H. Platt, C.B., Gorddinog, Llanfairfechan, 100 shares; J. Beecham, St. Helens, Lancs., director of St. Helens Cable Co,, Ltd., 100 shares; H. M. Cohen, 14, St. Helens Place, E.C., articled clerk, 1 share; and H. P. Dakin, 9, Silverlock Street, Rotherhithe, S.E., clerk, 1 share. Minimum cash subscription, 33,500 shares. The number of directors is not to be less than three nor more than seven; the first are J. E. Rawlins, J. Beecham, J. Tomkinson, M.P., H. Platt, C.B., and A. Deedes; qualification, £500; remuneration (exclusive of salaries to managing directors or committee of management) £200 each per annum (£50 extra for the chairman) and 5 per cent. of the profits divisible after paying 10 per cent. on the shares.

SUPPLY STATION ACCOUNTS.

Partick and Mexborough Municipal Electricity Departments.

We give herewith the first annual returns of the working of the recently established electricity undertakings of the Burgh of Partick, and U.D.C. of Mexborough.

In both cases these departments are worked in conjunction with a refuse destructor, and have a considerable proportion of street lighting. In the case of Partick, it is satisfactory to note that special efforts are being made to obtain that indispensable factor of success, a good motor load, and the low charges for lighting at so early a period of its existence, deserve the close attention of the many contemporaries who have not yet learned the secret of success.

Mexborough is an example of a smaller town, which it is true has only had 10 months' running; the motor load, however, is practically nil, and the charges for private lighting are practically double those at Partick, while no item of rates and taxes appears to swell the works costs.

The results show the necessity for facilitating a rapid extension of business, especially at the commencement of supply.

Mr. H. B. Maxwell is the electrical engineer at Partick, and Mr. H. Waring occupied a similar position at Mexborough during the period under review.

GENERAL STATEMENT.

	Mexborough.	Partick.
Period of accounts	10 months ending March 31st, 1903.	12 months ending May 15th, 1903.
Total capital expended	£16,164	£49,933
Number of units sold	102,439	342,924
Equivalent No. of 8-C.P. lamps connected	—	18,860
Maximum load in kilowatts	116	225
Number of public lamps	15 arc, 226 inc.	76 arcs
Revenue account. Gross revenue	£1,212	£3,729
Revenue account. Gross expenditure	£832	£2,258
Revenue account. Gross profit	£380	£1,471
Average price per unit sold	—	—

REVENUE STATEMENT.

	Gross.	Per unit.	Gross.	Per unit.
Sale of energy	£1,211	2·90d.	£3,724	2·60d.
Meter rents, &c.	1	·00d.	5	·07d.
Total revenue	£1,212	2·90d.	£3,729	2·67d.

In the case of Mexborough, of the 102,439 units sold, 73,100 were for public lighting, and this large proportion accounts for the average price being as low as 2·90d. per unit.

PUBLIC LIGHTING.

	Mexborough.	Partick.
Number of units supplied	73,100	169,167
Average price obtained	2·84d.	1·44d.

The charges are: Private lighting, 5d. per B.T.U.; power, 3d. per B.T.U. Partick also supplied nearly 50 per cent. of its output for public lighting; there were also 23 motors of 85 H.P. connected, and the prices charged are: Private lighting, 6d. and 1d. per unit, maximum demand, or 3½d. flat rate; power 1½d. per unit, with considerable discounts.

COST OF PRODUCTION.

	Gross.	Per unit.	Gross.	Per unit.
Coal	—	—	£555	·32d.
Destructor department	£340	·79d.		
Oil, waste and stores	16	·04d.	152	·11d.
Wages incurred in generation and distribution	204	·48d.	499	·35d.
Repairs and maintenance of engines, boilers, dynamos, distributing plant, buildings, &c.	33	·07d.	37	·02d.
Public lamps, attendance, repairs and renewals	68	·16d.	203	14d.
Total works and distribution costs	661	1·54d.	1,446	1·01d.
Rent, rates and taxes	—	—	352	·25d.
Management and general expense, including printing, insurance, and law charges	171	·40d.	460	·32d.
Total works costs	£832	1·94d.	£2,258	1·58d.

The financial results of the two undertakings are set forth below. In both cases, as is to be expected, a deficit results, but in the case of Mexborough the amount is reduced by the sum of £550, received as damages through late delivery of plant, hence the apparently small deficit. In the case of Partick, the gross profits are 3·3 per cent. on the capital invested, compared with only 2·3 per cent. in the case of Mexborough.

PROFIT STATEMENT.

	Mexborough.	Partick.
Interest	£408	£1,526
Sinking fund	285	943
Loan charges prior to commencement of supply	107	
Damages received for breach of contract	—550	
Deficit carried forward	—170	—435
By interest on deposits and suspense account	—	—563
Gross profit	£380	£1,471

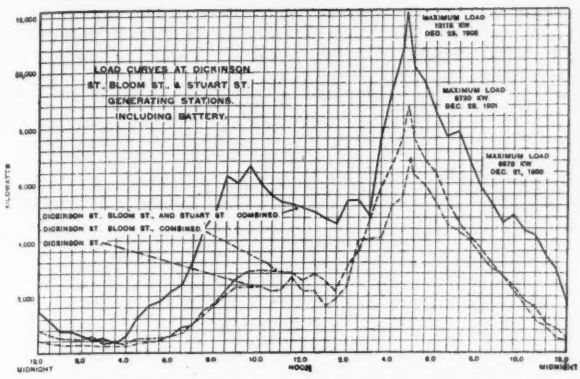
Manchester Municipal Electric Supply.

The affairs of the Manchester Electricity Department have attracted a large amount of attention from municipalists generally during the past year, and the returns possess more than ordinary interest in view of the largely extended capacity of the plant and the strenuous efforts which are being made to popularise the supply in Manchester and district. It is, therefore, of interest to record the excellent progress shown by the following figures:—

Year.	Units generated.	Private consumption.	Public lighting.	Traction.	Total sold.
1900	6,927,396	6,312,182	43,690	None.	6,355,872
1901	9,639,973	7,750,548	43,550	,,	7,794,098
1902	12,697,590	8,512,189	38,120	1,951,990	10,502,299
1903	22,198,241	9,373,846	40,305	7,986,072	17,400,223

The bulk of the increased output is due to the opening up of the electric tramway system, and no doubt this department will continue to extend during the next year or two.

The gross profit has increased proportionately to the larger capital employed, but the net profit credited to the reserve fund, although larger than in the previous year, shows a decreased percentage, due to greatly increased financial charges.


LOAD CURVES AT DICKINSON ST. BLOOM ST. & STUART ST. GENERATING STATIONS. INCLUDING BATTERY.
MAXIMUM LOAD 10175 KW DEC. 29, 1902
MAXIMUM LOAD 8730 KW DEC. 29, 1901
MAXIMUM LOAD 8670 KW DEC. 31, 1900
DICKINSON ST. BLOOM ST. AND STUART ST. COMBINED
DICKINSON ST. BLOOM ST. COMBINED
DICKINSON ST.
KILOWATTS
HOURS
MIDNIGHT
MIDNIGHT

As the extensions have been revenue earning during a portion of the year only, the above results are better than might have been anticipated, and, bearing in mind the excellent opportunities of the supply area, an enormous increase in power units is well within the range of possibility. The normal capacity of the plant is 23,050 KW., and the load factor for light and power was 11·83 per cent., and for traction 24·68 per cent., as compared with 12·31 per cent. lighting and 22·55 per cent. traction in 1902. Mr. G. F. Metzger is the city electrical engineer.

General Statement.

Year ending March 31st—	1902.	1903.
Total capital expenditure	£1,164,307	£1,713,627
Number of units sold	10,502,299	17,400,223
Maximum load in KW.	9,140	12,775
Equivalent 8-C.P lamps connected ...	348,709	398,659
Number of public arcs	29	29
Number of motors	774	1,025
Revenue Account. Gross revenue	£135,063	£197,768
" expenditure	£73,950	£112,188
" profit	£61,113	£85,580
Average price obtained per unit sold ...	3·07d.	2·72d.

Revenue Statement.

By sale of energy.	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.
Manchester	119,725	—	136,199	—
Withington	2 563	—	3,244	—
Moss Side	1,330	—	1,561	—
Levenshulme	—	—	119	—
Heaton Norris... ...	—	—	295	—
Tramways department	10,167	—	55,008	—
Public lighting... ...	318	—	336	—
	£134,103	3·07d.	£196,762	2·72d.
Meter rents	290	·00d.	349	·00d.
Sundry	70	·00d.	58	·00d.
By interest accrued ...	601	·01d.	599	·00d.
Gross revenue ...	£135,063	3·08d.	£197,768	2·72d.

The prices charged are, for private lighting, 5½d. per B.T.U., or a fixed charge of £7 per annum, per KW. of maximum demand, and 1¾d. per unit. For motive power the price varies from 1¾d. per unit for less than 150 units per H.P. in the quarter to 1d. per unit for 450 units and upwards per H.P.

Working Expenses.

	1902. Gross.	1902. Per unit.	1903. Gross.	1903. Per unit.	Inc.
Coal	£18,093	·49d.	£25,697	·36d.	—·06d.
Oil, waste, water and engine-room stores	4,605	·16d.	6,847	·09d.	—·07d.
Salaries and wages incurred in generation and distribution, &c.	7,766	·18d.	19,566	·27d.	·09d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and public lamps	19,985	·37d.	30,556	·42d.	·05d.
Works and distribution costs	£50,449	1·18d.	£82,666	1·14d.	·01d.
Rent, rates and taxes	7,782	·19d.	12,172	·17d.	—·02d.
Management expenses, salaries engineer, secretary, and clerical staff	9,179	·21d.	7,684	·11d.	—·10d.
General establishment charges, stationery, printing, law and insurance	5,120	·12d.	5,088	·07d.	—·05d.
Special charges	1,420	·04d.	1,727	·02d.	—·02d.
Expenses re vibration	—	—	2,901	·04d.	·04d.
Total expenditure	£73,950	1·69d.	£112,188	1·55d.	—·14d.

On the year's working—the costs of production show a decrease of ·14d. per unit—the items of wages and repairs, &c., have increased, as is usual during the first few months of working new plant.

Profit Statement.

	1902.	1903.
Interest on loans	£28,014	£43,738
Sinking fund	20,244	28,070
To public works loan commissioners ...	4,775	4,907
To reserve fund account	7,976	8,737
Provision for bad debts	104	128
Gross profit ...	£61,113	£85,580

The gross profit for the year amounts to £85,580, and after meeting financial charges amounting to £76,715 (as compared with £53,374 in 1902, and £39,433 in 1901), and providing £128 for bad debts, the balance amounting to £8,737, was carried to reserve.

CITY NOTES.

Crompton & Co., Ltd.

The fifteenth annual general meeting of this company was held on Wednesday at Salisbury House, London Wall, under the chairmanship of Mr. John Trotter, the chairman of the company.

In moving the adoption of the report, the Chairman said that the report gave some indication of the character of the past year. It had been one of exceptional hard work and small profits. The poor result was not due to any want of energy on the part of the directors or the staff of the company. The sales during the year were the largest they had yet had to deal with, but the goods turned out had to be sold cheaply owing to competition at home and from foreign manufacturers. Prices had been, therefore, kept at a very low level. He hoped that they would be able in the future to go back to the excellent years which they had up to two or three years ago. Competition in the various branches of their work had increased very much of late. For instance, up to about three years ago, for street lighting there were practically only three competitors in the field. Now, wherever there was a lighting order going, there were from 15 to 20. Then a few years ago municipal work, which was more and more coming into fashion in this country, was fairly remunerative; now the competition in that quarter was fiercer than in any other. There was no doubt that the Germans and the Americans were causing them a very considerable amount of trouble by sending over their surplus goods to this country. They were prevented from selling their goods in Germany by a protective tariff. The Germans made a handsome profit on their sales in their own country, and sent their surplus production over here at cheap rates, and very often they sold under cost price. He was afraid there was a good deal of truth in the statement that England was made a dumping ground for foreign manufactures. The question was—was such a policy doing the Germans any good? He did not believe that it was possible for long to continue to sell goods under cost, nor would it benefit the Germans in the long run. In a company like theirs they had to take into consideration the new question of the fiscal policy of the country, which had been suddenly sprung upon them; and the question was, what should be their attitude in the matter? He could only speak for himself, and it seemed to him that if they could get Protection for the electrical industry only they should vote for it with both hands. But, of course, that was out of the question, and if we were to have anything like a general return to Protection, he felt sure that, as far as their company was concerned, bad as their position might temporarily be, they would only be getting out of the frying-pan into the fire. It would only benefit them if they had Protection for a short time. It would so stimulate the production that they would be exactly in the same position as the Germans had got into by having Protection, and having their interests stimulated unduly. To him it appeared that the true remedy lay in a different direction. This country was having a rude awakening in the matter of its trade, and it seemed to him that the true remedy was one that pointed to an alteration in our methods. Much has already been done in the matter of education, but they must continue to educate and to improve the intelligence of the British working man. Then they must pay more attention and devote more skill to the matter of designing—they must adapt their productions more closely to the wants of their customers. Another important matter was that of standardising, to which Mr. Crompton had been giving considerable attention lately. If they limited the number of patterns and had regular standards, it would enable them to compete much more readily with the foreign trade. Then, he thought, they wanted to get consulting engineers to be less "faddy" in regard to designs, and a most important point was that they wanted a removal of municipal restrictions. As it was now, they very often had contracts brought to them where restrictions were imposed under the mistaken idea that they benefited the workman. Again, he thought, they wanted, if possible, to restrict municipal trading. England had been built up by individual enterprise, but with municipal trading there was a danger of things being done in a slip-shod way which was distinctly detrimental to English manufacturers. Those were the lines on which they should work, and with economies he saw no reason to doubt that they would soon see a return to

their former prosperous times. In conclusion, the chairman referred to the figures in the balance-sheet, and said that the directors had decided to maintain the dividend at 5 per cent., although it would mean that they would not carry forward as much as was brought into the account.

The motion was seconded by Lieut.-Col. R. E. B. Crompton, C.B., who said that during the year he had been doing what he could to forward the work of standardisation. A great part of their stock-in-trade was in the shape of components. These components were kept ready in bins, and a great deal of time was saved by the ready-made parts being put together as the orders came in. A great deal depended on the speed of the turnout at the works. The trouble was the large number of patterns which had to be kept in stock. They had been trying for a long time past to get the trade to consent to standardisation, and on one point they had come to an agreement—the parts of electric motors. With regard to the low prices, he thought that they had got to the bottom of those prices, and that they had turned, and now had an upward tendency.

The report was adopted.

Widnes and Runcorn Bridge Co.

The sixth ordinary meeting of the above company took place at Liverpool on July 28th. Sir Hy. Seaton-Karr, M.P., presided.

In moving the adoption of the report, the Chairman stated that the towers on each side of the river had been erected to a height of about 160 ft. The full height was 190 ft. The wires for the cables were undergoing satisfactory tests. The final contract for the electrical installation and equipment had been let to Messrs. Mather & Platt, Manchester. This work was to be completed in six months.

The Metropolitan Railway.

Addressing the shareholders of the Metropolitan Railway Co. at the half-yearly meeting last Friday, at the Cannon Street Hotel, Mr. Mellor, the Chairman, said that they had spent £1,000 during the half-year for the re-sleepering of parts of the line, which would not have been done but for the fact that they were about to put down two extra rails for electric traction, and thought it better, before doing so, to start with a thoroughly good road with new sleepers. Referring to the progress of the electrical installation, he said he was glad to be able to tell them that the contracts for the work were, for the most part, well in hand, and that the important works at Neasden, so far as they had progressed, seemed to be of excellent quality, and had so far proceeded without a hitch or drawback of any kind. The power house should be complete, with the machinery erected, by the end of this year. He had often visited the works, and had had abundant opportunities of judging both of the quality and of the materials and workmanship, and he might say that every month which witnessed the further progress of the work convinced them of the wisdom of the course they adopted when they decided to put down their own power house on their own land at Neasden. The boiler house and boilers, steam turbines, switchboards, electric cranes, and all the plant necessary to complete the installation, were all well in hand. The reservoir for the storage of the necessary condensing water—which had an area of about 2½ acres—would, they expected, be finished by the end of August. They had put down plant for lifting the water from the two wells they had sunk, from which the reservoir would be filled, and, they expected, they would be kept constantly supplied with good condensing water. They were also pushing forward the equipment of the permanent way, and they had made what they considered very favourable contracts for the conductor rails and for some new corridor, motor and trailer cars, which were now being built. The British Westinghouse Co. were supplying the whole of the machinery and plant, and thus they were practically responsible for the complete and efficient working of the whole of the electrical system. There would thus be no divided responsibility, and as to them would go the credit for the successful working of the whole installation, they had every possible inducement to do their very best to make the electrification a complete success. Referring to the effect which the electrical working of the line was likely to have upon the future prospects of the company, the chairman said that, as the months rolled by, he saw the electrification scheme approaching nearer and nearer completion; the magnitude of the work of conversion and the far-reaching consequences of that work, became every day more apparent, and he felt that none of them could quite realise what the change was going to do for them. He could only say that he believed the results would exceed anything the most sanguine of them had hoped for. He was not a sanguine man, but he was convinced he did not take too sanguine or too optimistic a view when he told them that he felt the strongest confidence that this electrification would inaugurate a new era of prosperity for the railway. He would remind them of the enormous advantages they possessed in the great size of their tunnels, constructed as they were to accommodate two broad-gauge trains, and consequently affording ample space for passengers to alight in the event of a mishap and walk to the nearest station—an advantage which they would easily understand would be of the utmost consequence in an emergency. Their nearness to the surface, again, and the wide openings for ventilation, were other great advantages. Assuming that they would carry 50,000,000 passengers per annum on the circle, the acceleration of speed which the use of electricity would give them would mean a saving in time to the travelling public of 300,000 days in a year—assuming that each passenger used the train for 12 minutes per journey. That saving would add just 30 per cent. to the capacity of the railway. If he was spared one year more he hoped and believed he would have the happiness of congratulating them on the completion of a work which had involved immense labour and anxiety on the directors and staff, but which he ventured to think would bring back to them the best days of the old Metropolitan.

Liverpool Overhead Railway Co.

The report of the directors, which is to be submitted to the meeting to be held at Liverpool on Tuesday, 11th inst., says that the gross revenue receipts for the half-year ended June 30th amount to £41,664 6s., and the working expenses to £32,005 8s. 9d.

"The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1901.	Half-year ending June 30th, 1902.	Half-year ending Dec. 31st, 1902.	Half-year ending June 30th, 1903.
First class	708,740	656,756	719,287	759,180
Second class, including tramways	3,321,856	2,966,690	3,384,621	3,334,793
Workmen (special return tickets)	1,402,858	1,402,976	1,336,396	1,420,116
Total ..	5,433,454	5,026,422	5,440,304	5,514,089

"The traffics shown above indicate a satisfactory increase, and although the working expenses, due to the acceleration of the trains, are larger, yet the service has proved to be popular, and is leading to a steady improvement in the number of travellers. The Bill of the Cheshire Lines Committee for powers to effect a junction with this company's railway at the Herculaneum Dock has received the Royal assent. The Bill of the Seaforth and Sefton Junction Railway, which will connect with the Liverpool overhead line at Seaforth, has passed the Committees of both Houses of Parliament. The negotiations with the Lancashire and Yorkshire Railway have made good progress. When this company's railway is connected up with these important main lines, it will form a valuable link in their through traffic, from which the directors anticipate considerable advantage.

Revenue Account.

	£	s.	d.
Receipts from passenger traffic amount to	40,858	13	0
Miscellaneous receipts and interest	805	13	0
	41,664	6	0
Less working expenses	32,005	8	9
	9,658	17	3
Deduct interest on mortgage debentures	3,800	0	0
	5,858	17	3
Add balance brought forward, December 31st, 1902 ..	4,013	8	7
Leaving available for dividend	9,872	5	10

Out of this balance the directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after August 15th, next:—

5 per cent. per annum on preference shares	£3,000	0	0
1¼ „ „ ordinary shares	3,125	0	0

leaving a balance of £3,747 5s. 10d. to be carried forward to next half-year."

Central London Railway Co.

The report of the Central London Railway Co. for the half-year ended June 30th last, which was submitted to the meeting yesterday, stated that the amount expended on capital account during the half-year was £84,373. The receipts from all sources amounted to £187,235, and working expenses to £94,350, leaving a balance of £92,885. There was again a large increase in rates and taxes, which were now equal to 15 per cent. of the net receipts. The number of passengers carried was 23,179,138, an increase of 299,804. After providing for interest on the debenture stock and special expenses, amounting to £1,947, attending the vibration inquiry, there was a balance of £102,406, including £27,717 brought forward. The directors recommended a dividend on the ordinary and preferred stock at the rate of 4 per cent. per annum. After putting aside £10,425 for the proportion applicable to the deferred stock—the dividend on which is not payable until the result of the year's working has been ascertained—there remained an unappropriated balance of £45,406. The whole of the trains are now worked by motor-cars on the multiple unit system. It is anticipated that this improved service will enable the company to give better accommodation to the public, and that, with further experience, material economy in working will result. To enable the lifts to be worked independently of the main service, a new sub-station is in course of construction at Bond Street Station. The large fan at Shepherd's Bush for the ventilation of the tunnels has been erected and tested, and will, as soon as possible, be regularly worked.

The sixteenth ordinary general meeting of the shareholders of this company was held on Wednesday at the Holborn Restaurant, Sir Henry Oakley, the chairman, presiding.

In proposing the adoption of the report, the Chairman said that the Bill which the company had in Parliament had been suspended in common with all Bills relating to tube railways, pending the report of the Royal Commission which was inquiring into the question of London locomotion. He believed that some statement would be made upon the subject in the course of a few days, and they would then know whether their Bill was likely to be suspended over next session. Passing to the accounts, he said that the capital account remained practically the same, but they had continued to spend money in sundry improvements which would sooner or later have to be provided by capital. At this moment capital owed

revenue about £103,000, which they would have to replace in the course of the year. £119,000 had been spent on additional motor cars and carriages, to carry out the recommendations of the Board of Trade Committee which sat to inquire into the question of the vibration caused by their engines. They had bought 68 motor carriages, and these had been worked for some time with remarkable success. They were more economical as far as coal consumption was concerned, and they also facilitated the despatch of the trains at either end, as no time had to be wasted in changing engines. Of course there was a disagreeable side to the question, viz., that it had thrown out of use a number of engines, which had been paid for out of capital, representing a value of £69,000. Of course those engines were worth something, and they were endeavouring to find a market for them, but the difference between what they realised and their cost to capital would have to be met out of revenue, so that the capital might always be represented by useful working material. The knowledge that they would have to make that provision had had its effect upon the dividend. They had also established, at Bond Street, a sub-station for the purpose of enabling the lifts and the lighting to be worked independently of the main service for the railway, so that in case of any interruption to the main current the tunnels and the stations would not be deprived of light. The shareholders would remember that they had established a large fan at Shepherd's Bush to pump air into the tunnels. It had only recently been completed, and he could not go into detail as to its effectiveness; but he was pleased to say that on the few nights they had had it in full work they were able to change the whole of the air in the tunnel three times within each hour, and he was told by travellers that in the morning the freshness and sweetness of the air were remarkable. To be quite frank, he could not say that that freshness continued throughout the whole of the day, but he had no doubt that as soon as they knew what they wanted they would be able to find a remedy, so as to make the tunnels what they desired them to be—the pleasantest places in London. They had carried during the half-year more than 300,000 more passengers than they did in the corresponding half of 1902, but it must be remembered that last year the railway benefited greatly by the influx of passengers on the days assigned for the celebration of peace and the Coronation respectively; and discounting that extra traffic, it was estimated that the increase in regular passengers last half-year was about 350,000; and for the whole year they had increased by about 600,000. That, he thought, was a most convincing proof of the popularity of the line, and of the steady and reliable manner in which the traffic was increasing. It was interesting to note that they had carried 2,900,000 workmen—representing about 12½ per cent. of the total number carried—at half-price, and the effect on their receipts was that they earned rather more than 1¾d. on every passenger they carried. They had earned £2,100 more last half-year than in the corresponding six months, and as far as the working expenses were concerned, had done it at a saving of £3,000. Unfortunately, however, their rates and taxes had increased by £4,301, so their net saving was only £700. The poundage on all their properties which they had to pay for rates and taxes worked out at about 6s. 8d. in the £. They were endeavouring to prove that they were unfairly taxed in relation to other properties; but in the meantime there was nothing for them but to pay. The net balance available was £102,406, which included £27,717 brought forward. The vibration experiments having been concluded, they had thought it right to debit the revenue with the costs of that, amounting to nearly £2,000. Out of the balance of £102,000 they proposed to pay a dividend at the rate of 4 per cent. on all the stocks, leaving £45,000 to be carried forward.

The report was adopted.

Great Northern and City Railway Co.

The 10th half-yearly general meeting of the shareholders of this company was held on Tuesday at the Westminster Palace Hotel, Sir Charles Scotter presiding.

The Chairman, in proposing the adoption of the report, said he was glad to say that the line was practically complete between Moorgate Street and Drayton Park. The whole of the machinery and the generating station was finished, and ready for working to-morrow. A great part of the rolling-stock had been already delivered, while the remainder was practically complete; so that they were in a very forward position to take advantage of the time when the contractors were able to call in the Board of Trade to inspect the line, and make it ready for traffic. The extension from Drayton Park to Finsbury Park was in a very forward state, and their engineer reported very favourably upon the progress of the work. Since they began they had had the cordial co-operation of the Great Northern Railway Co. in carrying out that most important extension; and, so far as he could see at present, there was no reason why that particular portion of the line should not be completed within a very short time. He thought he was justified in saying that before they met for the next half-yearly meeting the line would practically be open for traffic between Moorgate Street and Finsbury Park. The shareholders would remember that they looked upon the extension to the Bank as being a very important part of the line, and that particular portion would not be completed yet, but they did not intend to delay the opening of the line until the extension to the Bank was finished. As soon as the extension to Finsbury Park was ready and the station there complete, they would open the railway to public traffic, and they had every reason to believe it would meet with success. That was the tenth report they had submitted, so that practically the line had been before them five years, and when they considered the magnitude of the work, he did not think that, on the whole, they had any cause for dissatisfaction at its progress. They anticipated a very heavy traffic even to Moorgate Street, but they were quite certain that the traffic would be considerably increased when they were able to announce that they could carry passengers from Finsbury Park to the Bank.

The Earl of Lauderdale seconded the motion, and the report was adopted.

Subsequently a special meeting was held, when the following resolutions were unanimously agreed to:—

"1. That the £450,000 additional capital authorised by the Great Northern and City Railway Act, 1903, to be raised, be, in exercise of the powers conferred on the company by that Act, hereby created, and that such capital be issued as preference shares or stock bearing interest at a rate not exceeding £4 per cent. per annum upon such terms and conditions and in such manner consistent with the provisions of the said Act as the directors shall think fit."

"2. That the £150,000 debenture stock authorised by the Great Northern and City Railway Act, 1903, to be created, be, and is hereby created, and that such stock be issued and disposed of by the directors at such times and on such terms and conditions and in such manner consistent with the provisions of the said Act as the directors may determine."

Anglo-American Telegraph Co.

Mr. F. A. Bevan, presiding at the meeting of this company at Winchester House, E.C., on Friday last, said that the traffic receipts, compared with the corresponding period of 1902, had increased by £9,278, and the charter of the *Minia* for repairs executed on the cable of another company amounted to £4,999. The total increase of receipts was £14,012. There was an increase of £3,407 in the working expenses, chiefly normal increases of wages and various items at stations. There had also been a repair of a minor nature to the cable which broke very near Valentia, which cost altogether £3,485. The total increase in the working expenses was £6,962, and this, deducted from the increased revenue, left £7,049 advance. The traffic account balances had increased, but that was occasioned by the increases in the traffic balances consequent upon this company carrying other companies' traffic during the year. When their cables were broken, this company had to carry their traffic, and there had been rather more than usual arising from that source. They had had to repair one of their 1873 deep-sea cables during the half-year. The renewal fund showed £12,190 as the expenses, so far, but this did not represent the whole cost. They could not say exactly what it would amount to, but it might be another sum of the same amount. When they came to consider the cost of those deep-sea repairs, this was really a very moderate amount. They had managed to make that repair—inserting 43 miles of new cable—and their captain and experts on the *Minia* had performed their work with the greatest possible dexterity. The Direct United States Cable Co. had also had to effect a repair of that kind, and the sum debited on that company's account was considerably larger than in the case of this company. They (the directors) always told the shareholders that they had to face the contingency of one of their old cables being in such a condition that it could not be lifted. He was glad to say that that had not been the case here. Though they had lifted it again and again, and found it bad, they did at last come upon a good sound bit of cable, which was hanging, as it were, upon the top of a mountain. The sounding in that part of the Atlantic was something like 2,300 fathoms, but there was a mountain range there, and they had only to go down 700 fathoms, a little distance away. This showed the very uncertain nature of the bottom of the Atlantic. They had also a small repair nearer home, for which they had to charter another vessel. It was not thought worth while to bring the *Minia* across the Atlantic to execute the repair, so they chartered the *Britannia*, and the repair was executed in a very short time. The telegraph conference had been sitting in London. The tendency of its proceedings had been rather to reduce, probably, the profits of the cable companies, but he hoped not to any considerable extent. He was not very sanguine about the prospects of this half-year, but they hoped that the results would be as satisfactory as during the last half.

Sir Gerald Fitzgerald seconded the motion, which was adopted after some little discussion.

Great Northern, Piccadilly and Brompton Railway Co.

The half-yearly ordinary meeting of shareholders in this company was held on Saturday at Hamilton House, Sir Henry Fowler presiding.

The Chairman said that the capital expenditure during the half-year amounted to £658,331. The total expenditure to date was £900,326. The amount of share capital created was £4,825,000, and the amount still unissued was £4,003,450. The estimated expenditure for the current half-year was £750,000. The engineers' report showed satisfactory progress with the construction of the works. The rent became due from the Underground Electric Railways Co., Ltd., on Saturday. A dividend was declared at the rate of 4 per cent. per annum.

Metropolitan District Railway.

The report of this company for the half-year ended June 30th last, to be submitted to the meeting yesterday, states that the receipts for the half-year have been £202,518, and the working expenses £112,982, showing a profit of £89,535, against £90,372, a decrease of

£836. The number of passengers carried was 24,022,866, an increase of 3,471,665. Passenger receipts amounted to £185,673, a decrease of £2,350. After paying the interest on debentures and debenture stock and the several rent charges, there is a balance of £18,127. This amount provides a dividend on the 4 per cent. guaranteed stock at the rate of 2 per cent. per annum, and leaves £342 to be carried forward. The Ealing and Harrow Railway was opened on June 28th, and is being worked by an electrical service of trains. The Hounslow Railway has been acquired by the company. Upon the Whitechapel and Bow line a large traffic is being carried, but this line cannot be properly utilised until the railways are worked electrically and arrangements made for a greatly increased through service of trains over the Tilbury Railway. The work of converting the railway from steam to electrical traction is steadily progressing. The power house at Lot's Road is well advanced. The sub-stations are in a forward condition, and all necessary arrangements have been made with the Board of Trade and the public authorities for laying the cables. A consultative committee of the District and Metropolitan Companies has met from time to time to confer upon electrical questions affecting the two companies.

Prospectuses.

THE North Wales Power and Traction Co., Ltd., is the title of a new company formed to develop the water power of the lakes in the neighbourhood of Snowdon and Conway, by establishing hydro-electrical generating stations, and supplying energy to local railways and tramways, also to a large number of quarries which exist in the neighbourhood. The capital is £270,000 in 54,000 £5 shares, and the issue covers 50,600 shares. The directors' power to issue debentures is limited to £135,000 in the first instance.

The company acquires control of the Portmadoc Beddgelert and South Snowdon Railway, authorised last year, with the initial object of purchasing, electrifying and extending the Croesor Railway to some 13 miles in length, and in addition of supplying electricity for lighting and power over a portion of the County of Carnarvon.

Mr. S. B. Cottrell, the engineer to the Liverpool Overhead Railway Co., has estimated a revenue of £18,962 from these sources, and, in addition, a large revenue, estimated at £57,700, may be expected from the 5,000 E.H.P. surplus power which the company will possess.

In connection with the capital expenditure, £145,000 is the estimated cost of the extension and electrification of the railway, the construction of dams, &c., and power house, £35,000 in respect of transmission lines and transforming stations, £12,000 for the purchase of the Croesor Railway, and £80,000 for the purchase of various properties and preliminary expenses.

The consulting engineers to the scheme are Messrs. Sir Douglas Fox and partners, the engineers Messrs. Harper Bros. & Co., and the secretary and offices (*pro tem.*) Mr. F. B. Fuller, 1, Leadenhall Street, E.C. The list closes to-day.

A prospectus is to hand from the Consolidated Electrical Co., Ltd., who are issuing the balance (£15,000) of their authorised capital as cumulative 6 per cent. Preference shares.

This company is a reconstruction of the Consolidated Telephone Construction and Manufacturing Co., Ltd., whose business was taken over as a going concern. The authorised capital is £125,000, in £1 shares, of which 109,096 have been issued as ordinary shares, and 904 are held in reserve. The object of the reconstruction was to provide the undertaking with working capital for the development of its business, which lies mainly with the Government departments, the railway companies, and municipal authorities. An initial cash capital of £28,000 was then secured, of which some £16,000 is still uncalled.

The object of the present issue of preference shares is to pay off certain liabilities in the shape of debenture shares, taken over by the new company, and they will constitute a first charge on the calculated assets (exclusive of goodwill), amounting to £80,000.

The net profits of the old company for the last three years are certified at £2,982, £2,474 and £2,497; the estimated additional income from shares held in the Anglo-Portuguese Telephone Co., Ltd., is nearly £2,000 per annum, and a trading profit of 10 per cent. on the new capital brought into the reconstructed company would further increase the income by about £2,500 per annum, giving an estimated net income of from £5,000 to £7,000 per annum, on which the preference dividend of £900 ranks as first charge. Holders of ordinary shares in the company will have preferential treatment over members of the public in the matter of allotment.

The list opened on Friday, July 31st. The secretary is Mr. Theo. Taunton, and the registered office Northampton Grove, Canonbury, N.

Charing Cross and Strand Electricity Supply.—On the 4th inst. the directors of this corporation declared an interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, 1903.

Primitiva Gas and Electric Lighting Company of Buenos Ayres.—A meeting of the owners of 4 per cent. debentures of this company will be held at River Plate House, Finsbury Circus, on Wednesday next at 3 o'clock, for the purpose of considering three extraordinary resolutions in regard to the agreement between the company and the Deutsch Ueberseeische Elektricitäts-Gesellschaft.

STOCKS AND SHARES.

Wednesday Evening.

MARKETS are settling into their usual stride after the August Bank Holiday, but the number of people who are out of town is an all-sufficing reason for quietude of business. During the next few weeks there will be very little doing, and consequently little to write about. Daring is the promoter who ventures to appeal for fresh capital in the holiday month, unless it be that he has wares in the shape of new issues carrying a substantial bonus to existing shareholders. And it may be wondered whether even a first-class electricity supply concern would receive much popular support were it to ask for money just now, although, of course, the capital would easily be provided elsewhere. We hear rumours of several new power companies, the prospectuses of which tremble on the edge of issue; the North Wales Power and Traction is one of the first to make its interesting appearance. In returning subscriptions from applicants who wrote for the new Mono-Rail shares, the directors hint that the scheme is yet far from dead, and it would be a thousand pities if so novel a venture were to fail of attainment through lack of money. The prophet-optimist already foresees the day when the success of similar schemes will cause the capitalist to tear his hair at having missed the opportunity of taking up the initial shares offered in Great Britain.

But home railway stocks of all kinds are out of favour, notwithstanding a good dividend and reports now being issued. Central London Ordinary is down a point, after falling lower, but the Preferred stock has improved to the same extent, while the Deferred shed 2; City and South London remain unchanged. On Tuesday last Sir Charles Scotter, at the Great Northern and City Railway meeting, said that he hoped the line would be open for traffic between Finsbury Park and Moorgate Street before another six months had passed. Meanwhile the "A" Preferred shares of this company stand at 8 for the £10 fully-paid shares. Great Northern, Piccadilly and Brompton Ordinary are a shade under par. Both the Underground stocks continue dull, although the District did very well on Bank holiday, with its electrified extension to Harrow. The comfortable saloon carriages had as much as they could do to cope with the traffic in the busy parts of the day.

The London United Tramway cars were packed from early morn to late at night, but the Preference shares keep about 12, and the Debenture stock remains at 106. British Electric Traction Ordinary are hardening a trifle, although no quotable change is seen in the price. Anglo-Argentine Trams are 4⅝, Cape Electrics 2⅛, and Calcutta 7. Buenos Ayres and Belgrano 5 per cent. Second Debentures have been changing hands pretty frequently about par, and Brisbane Electric Tramways Preference have been done at 4½ this week. The Ordinary are nominally 3, and Debenture 13½, *ex* the 5s. a share deducted on the last pay-day. Metropolitan Electric Deferred hang about 5s., and the Preference are just their par value of a sovereign, while New General Tractions languish at 15s. for the fully-paid £5 shares; the Preference, of similar denomination, command about half their nominal value. Potteries are 10, for Ordinary and Preference shares alike.

Electricity Supply shares are a very quiet market. A fall of ¼ in City Ordinary is balanced by rises of 5s. in Smithfield Markets and South London shares. There is a certain amount of business passing, but not enough to cause much fluctuation in values. In this connection it may be of indirect interest to notice that Gas Light and Coke Ordinary stock has begun to creep up in price again, the company making a better report, and generally demonstrating that electricity has not killed the older illuminant. Bournemouth and Poole Ordinary are marked at 13, and there has been a little doing in Primitiva Gas and Electric of Buenos Ayres Debenture, the nominal price of this 4 per cent. bond being 94. Bromptons have improved ¼, and "Jimmies" are a good market.

In the Telegraph division, Submarine Cables Trust certificates are $4 higher, but the only change in the Anglo-American trio is a decline of ¼ in the Deferred. Cuba Ordinary have advanced 10s., the recent jump in the Preference having directed attention to the junior shares. Eastern Ordinary lost its small improvement of last week, but West India and Panama Second Preference regained their lately lost pound. The septet of National Telephone issues is uninteresting, only the usually immobile Second Preference moving up 10s., which brings them into line of quotation with the First Preference shares. In the Miscellaneous list there has not occurred a solitary change.

Brompton and Kensington Electricity Supply Co.—The directors of this company have declared a dividend on the ordinary shares for the half-year ended June 30th last at the rate of 9 per cent. per annum, 4s. 6d. a share.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 29th.	Closing Quotations Aug. 5th.	Business done week ended Aug. 5th, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	47 — 50 xd	47 — 50 xd	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94 xd	92 — 94 xd	93½	92
3,105,580	Do. do. do. Deferred	Stock	5s. %	2s.	1/-	8½— 9	8½— 8¾	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	6 %	4½— 5 xd	4½— 5½ xd	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	150 —160	150 —160	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	92 — 95	93½	93
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6½— 7½	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	17 — 18	17 — 18	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	4 %	2½— 3½	2½— 3½	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	6½— 7½	6½— 7½	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	97 —101 %	97 —101	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3½%	10 — 10¼	10 — 10¼	10½	10¼
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	129 —134	128 —133	130½	129
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	88 — 91 xd	89 — 92	90¼	89
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	107	106½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½ xd	12½	12
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107 xd	106 —109	106½	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	100 —103	98 —101 xd	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	9 — 9¼ xd	9 — 9¼ xd	9⅛	..
180,042	Do. do. 6 % Pref.	10	..	..	..	12¾— 13¼ xd	12¾— 13¼ xd	13⅛	13
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 23	22 — 23	..	..
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	99 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	..	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	§National Telephone, Pref. Stock	100	5 %	5 %	6 %	100 —102 xd	100 —102 xd	101½	100¾
1,966,667	Do. do. Def. Stock	100	..	..	4½%	79 — 81 xd	79 — 81 xd	80⅛	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14 xd	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½ xd	13 — 14 xd	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5½ xd	5 — 5½ xd	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	96 — 98	96 — 98	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	101 —103	101 —103	102½	101¾
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	1⅛— 1⅝	1⅛— 1⅝	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,839	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	112 —117	113 —118	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5½— 6	5½— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	104 —107	104 —107	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	95½	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	..	12 — 12½	12 — 12½	12⅝	..
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	97 —100	..	..
88,321	West India and Panama Telegraph	10	½%	..	..	⅜— ⅝	⅜— ⅝	..	..
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6½— 7	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	4 — 5	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	98 —101	98 —101	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	77 — 82	77 — 82	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	11¼— 11¾	11¼— 11¾	11⅝	11 7/16
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	11½— 12	12 — 12¼	12	11½
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	123¼—125	..	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾— 7¼	6¾— 7¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¼— 5¾ xd	5¼— 5¾ xd	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —106	102 —106	104½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	3/16— 1/8	3/16— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	1¼— 1½	1¼— 1½	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1 — 1⅛	1¼— 1⅜	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	87 — 92	87 — 92	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	11½— 12¼	11½— 12¼	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¼— 5¾	5¼— 5¾	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	106 —110	106 —110	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	103 —106	103 —106	..	..
494,093	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	101 —104	102 —105	..	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	107 —110	105 —108	105½	..
1,330,000	City and South London Railway	Stock	1½%	2 %	2½%	63 — 65 xd	63 — 65	63½	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2 — 2½	2 — 2½	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —105	101 —105	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	2½%	Nil	..	1¼— 2½	1½— 2½	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	71 — 75	71 — 75	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾— 1¾	1¾— 1¾	1¾	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2½— 3	2½— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	..	..
85,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	108 —112	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18¼— 19½	18½— 19¼	..	..
800,000£	Do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5¼— 5¾	5¼— 5¾	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10½— 11	10½— 11	..	..
37,350	Telegraph Construction and Maintenance.	12	17½%	20 %	20 %	32 — 35	32 — 35	35	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	100 —103	100 —103	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	97 —100	97 —100	..	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring, ⅜—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14¾.
Do. do. Pref. (£10 pd.), 10—10¼.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations July 29th.	Closing Quotations Aug. 5th.	Business done week ended Aug. 5th, 1903. Highest.	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	‡	..	..	..	⅜— ⅞	⅜— ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	1	..	..	..				
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	100	..	..	..	118 —121	118 —121	..	..
20,000	Do. do. 7% Cum. Pref. ..	5	6 %	8 %	8 %	10¼— 11	10⅜— 11¼	11	..
50,000	Charing Cross and Strand Electricity Supply	5	..	..	..	10⅜— 10⅝	10⅜— 10⅝	..	..
70,000	Do. do. do. 4½% Cum. Pref. ..	5	9 %	10 %	10 %	9 — 9½	9 — 9⅝	9⅝	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	5¼— 6	5¼— 6	5	..
250,000	Do. do. 4 % Deb. Stock Red.	5	..	..	..	4⅜— 5	4⅜— 5	..	..
44,436	*Chelsea Electricity Supply, Ord.	100	..	..	..	104 —103	104 —106	106	..
150,000‡	Do. do. % Deb. Stock Red.	5	5½%	4 %	4½%	5⅜— 6½	5⅜— 6½	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	Stock	..	..	..	107 —110	107 —110	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	0 %	5 %	5 %	11 — 11½	10½— 11	10½/16	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	10	6 %	..	..	13 — 14	13 — 14	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	..	..	..	..	121 —126	121 —126	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	100	..	..	..	102 —105	102 —105	104⅜	104½
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	4 %	4 %	4 %	8 — 9	8 — 9	8⅝	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red ..	10	..	..	..	11½— 12½	11½— 12½	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	..	..	..	..	109 —112	109 —112	..	..
80,000	Do. do. 6 % Cum. Pref.	5	7 %	7 %	7 %	6½— 6⅝xd	6½— 6⅝	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	..	..	..	..	6 — 6⅛	6 — 6⅛	6 5/16	6¼
21,000	Kensington and Knightsbridge Electric, Ord.	100	..	..	..	106 —109	106 —109	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	5	12 %	10 %	10 %	10½— 11½xd	10½— 11½	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	Stock	..	..	..	103 —106	103 —106	..	..
49,840	Do. do. do. 6 % Pref.	3	..	..	..	2 — 2¼	2 — 2¼	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	5	..	..	..	5¼— 6	5¼— 6	5 5/16	..
100,000	Metropolitan Electric Supply, 1 to 100,000	Stock	..	..	..	100 —102	100 —102	..	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	10	6 %	6½%	7½%	17½— 18½	17½— 18½	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	..	..	..	..	108 —112	108 —112	..	..
10,852	Notting Hill Electric Lighting	Stock	..	..	..	97 —100	97 —100	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	10	7 %	6 %	6 %	13 — 14	13 — 14	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	14½%	14½%	14½%	15 — 16 xd	15⅝— 16⅝xd	15 15/16	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	5	..	..	..	8 — 9 xd	8 — 9 xd	..	..
12,000	Smithfield Markets Electric Supply, Ord.	100	..	..	..	98 —101	98 —101	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	2½%	3 — 3½	3⅛— 3⅜	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	1¾%	3½— 4	3⅞— 4⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5¼	5 — 5⅛	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12½— 13¼xd	12⅛— 13⅛xd	12 15/16	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6½	6 — 6¼	6 5/16	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS. Wednesday, August 5th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90%)	per gal.	7/-	..
a	,, (50/90%)	per gal.	5/6	..
a	Copper Sulphate	per ton	£19	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%).. ..	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	136/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 5	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70%) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £145	..
c	Brass (rolled metal 2' to 12')	per lb.	6¾d.	..
c	,, Tube (brazed)	per lb.	8¼d.	..
c	,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c	,, Wire, basis..	per lb.	7d.	..
c	Copper Tubes (brazed)	per lb.	9d.	..
c	,, ,, (solid drawn) ..	per lb.	9½d.	..
g	Copper Bars (best selected ..	per ton	£71	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec
g	Copper Sheet	per ton	£71	..
g	,, Rod	per ton	£71	..
e	,, (Electrolytic) Bars ..	per ton	£64	..
e	,, ,, Sheets ..	per ton	£74	..
e	,, ,, Rod	per ton	£66	..
e	,, ,, H.C. Wire	per lb.	7¾d.	..
f	Ebonite Rod	per lb.	3/8	..
f	,, Sheet	per lb.	3/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	3/11 to 4/¾	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	46/11	½d. inc
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£11 12 6	..
g	,, ,, Sheet	per ton	£11 15	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 12 6	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	,, ,, medium	per lb.	2/6 to 3 9	..
d	,, ,, large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet	per lb.	From 1/2	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	10d. to 1/-	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£128 to £129	..
g	,, Foil	per lb.	1/8	..
n	,, Wire, Nos. 1 to 16	per lb.	1/7	..
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¼d.	..
j	,, 6 lea. Flax	per lb.	5⅝d.	..
j	,, 8 ply 10 lbs. Russian ..	per lb.	4 1/16d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Tull & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co. *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	Aug. 1	1,251	— 68	11,691	+ 1,356	10	—
	Birmingham	,, 2	5,112	+231	156,110	+ 7,269	—	—
	Bournemouth	July 15	1,105	—	—	—	10½	—
	Blackburn	June 26	909	—286	11,668	+ 674	12¾	+1¾
	Blackpool	July 30	1,541	+ 29	17,042	+ 1,352	8½	—
	Blackpool and Fleetwood	Aug. 1	1,176	— 7	5,012	+ 271	7¾	—
	Bolton	,, 2	1,791	+182	24,093	+ 4,810	25	—
	Bradford	July 26	4,165	+1060	64,240	+10,267	39	+2
	Brighton	Aug. 2	1,083	+ 35	29,847	—	6½	—
	Bristol	July 31	5,114	+267	—	—	28	—
	Burnley	Aug. 1	825	+145	—	—	7½	—
British Elec. Trac. Co.	Barnsley District	July 24	185	—	5,198	—	4¼	—
	Devonport	,, 24	585	+111	12,758	+ 463	5	—
	Dudley—Stourbridge..	,, 24	889	+ 60	23,477	+ 2,377	18¾	—
	Gateshead	,, 24	915	+ 84	24,976	+ 4,277	10½	+ ¾
	Gravesend—Northfleet	,, 24	276	—	6,493	—	3½	—
	Greenock—Pt. Glasgow	,, 24	696	+ 53	15,449	+ 1,382	7½	—
	Hartlepool	,, 24	937	— 18	7,509	+ 428	6¾	+2
	Kidderminster	,, 24	140	— 4	3,649	+ 208	4½	—
	Merthyr	,, 24	207	+ 10	5,708	— 241	3	—
	Middleton	,, 24	407	+116	9,215	+ 999	8½	—
	Oldham—Ashton ..	,, 24	602	+ 40	16,594	+ 1,455	8	—
	Peterborough	,, 24	165	—	4,034	—	—	—
	Poole	,, 24	241	+ 52	8,276	+ 1,329	8¾	—
	Potteries	,, 24	1,584	+ 50	45,151	+ 2,858	20	—
	Rothesay..	,, 24	223	+212	3,793	+ 1,350	2¾	—
	Sheerness	,, 22	90	—	1,430	—	2½	—
	Southport	,, 24	397	+ 55	8,582	+ 1,762	6½	—

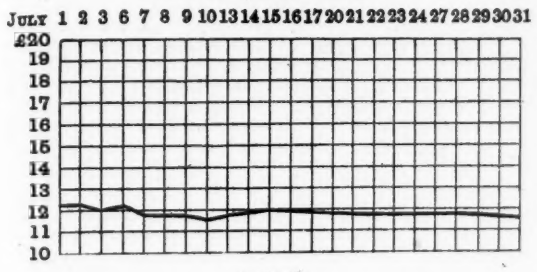
* Compared with the corresponding period of 1902.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open. *
B.E.T. Co.	South Staffordshire ..	July 24	1,043	+273	24,745	+ 2,039	21½ —
	Swansea	,, 24	573	— 87	14,514	+ 1,013	5¼ —
	Taunton	,, 24	66	— 2	1,657	— 139	1½ +1½
	Tynemouth	,, 24	454	— 12	8,556	+ 875	3½ —
	Weston-super-Mare..	,, 22	267	+ 27	2,608	— 236	2½ +2½
	Wolverhampton Dist.	,, 24	409	+ 77	11,290	+ 6,250	10½ +8
	Wrexham	,, 24	130	—	2,310	—	— —
	Yorks. Woollen Dist...	,, 24	397	—	6,684	—	6 —
	Cardiff	,, 25	2,136	+593	33,192	+11,747	14 —
	Chatham & District Co.	,, 28	653	+163	14,524	+11,769	8½ —
	Dover	Aug. 1	270	— 7	6,515	+ 121	3 —
	Dublin	July 31	5,575	+501	28,636	+ 5,777	46 —
	East Ham	Aug. 1	658	+166	12,118	+ 3,847	5 + ½
	Glasgow	,, 1	12,409	+1241	120,409	+15,635	55 +1½
	Hull	,, 1	1,827	+146	32,636	+ 2,017	11 + 1
	Ilkeston	July 29	190	—	—	—	4 —
	Isle of Thanet	Aug. 1	1,407	—185	17,217	— 447	10½ —
	Leeds	,, 1	5,659	—655	101,998	+ 5,934	41 —
	Liverpool	July 25	10,816	+573	296,566	+11,082	101 +2½
	Manchester	,, 25	12,417	+7062	—	—	110 +55
	Newcastle	,, 25	3,510	+638	—	—	17 —
	Portsmouth	,, 25	2,026	+230	—	—	29 —
	Salford	,, 27	4,055	+1867	63,473	+16,687	30 —
	Southampton	,, 23	1,115	+119	—	—	9 —
	Sunderland	,, 27	1,426	+222	20,631	+ 669	18 +1½
	Central London Railway	Aug. 1	6,175	+191	32,837	+ 265	6 —
	City and S. London Ry.	,, 2	2,565	—142	12,519	— 1,069	6¼ —
	Dublin and Lucan Elwy.	July 26	197	+ 74	5,412	+ 47	7¼ —
	Liverpool Overhead Rv.	Aug. 2	1,734	+ 94	8,670	+ 5 3	4¾ —

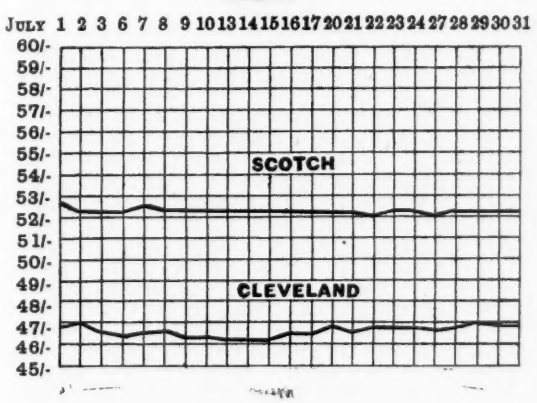
METAL MARKET.

Fluctuations in July.

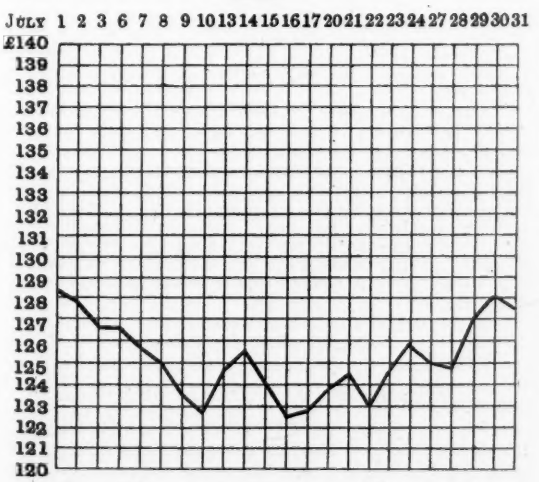
LEAD (ENGLISH).



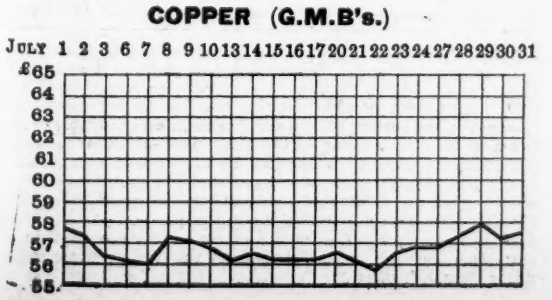
IRON.



TIN.



COPPER (G.M.B's.)



THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

The discussion of the papers at the recent convention disclosed considerable differences of opinion upon the question of Municipal *v.* Private Enterprise, in connection with the supply of electricity.

This is not surprising, for, as a local editor remarks in commenting upon the meetings, "People who appreciate the perils connected with municipal trading, and who have begun to realise the weight of the millstone of local indebtedness which is being fastened to the neck of the nation, will regard the statistics with very different feelings."

It is not to be wondered at that the President should have called attention, in his address, to this trend of public opinion, when he remarked that, "During last year there had been an outburst from a section of the community against municipalisation, and there could be no question that Parliament apparently intended to restrict them to narrower bounds."

Under such auspices the attempts to compare the results of the municipal and private trading to the advantage of the former met with anything but enthusiastic endorsement in the discussion which followed the reading of the papers. There seemed, however, to be a general agreement as to the necessity of providing an adequate reserve fund.

Mr. Alderman Smith's statistics were subjected to severe criticism, and such a prominent authority as Mr. Vesey Brown, who has enjoyed the experience of being a municipal electrical engineer, did not hesitate to say that the comparative tables were misleading.

Mr. W. H. Madgen (who was, we think, one of the originators of the Municipal Association) strongly denounced the statements in the paper, emphasising the fact that the outlay by Corporations of £90 per kw., against £117 by companies, did not take into account all the expenditure incurred, nor the fact that the mileage of mains laid entered largely into the question. He pointed out that many corporations had reaped the benefits of the pioneer work carried out by the companies, and he might have added that even in those cases they had not always succeeded in making the undertakings pay, if adequate provision for depreciation is taken into account, which was very generally conceded as necessary, even by prominent members of municipalities.

The remarks of the Scottish local authorities on the subject of depreciation were of especial interest, and to paraphrase the words of a municipal contemporary, they must have come "as a supplemental shock" to those who have so persistently advocated municipal trading in electricity on the basis of the sinking fund providing for depreciation, and the advantage to the rates of the profits derived from the undertakings.

Bailie Willock, of Glasgow, regarded it as an exploded idea that a surplus should be used to reduce the rates, arguing that it would be unfair between the workman and the more wealthy ratepayer. The proper plan was to reduce prices rather than contribute to the rates. The Glasgow Corporation has always recognised the principle of a depreciation fund. Bailie Mackenzie, of Edinburgh, favoured by preference the formation of a reserve fund, and also disagreed with placing profits to the relief of the rates. He was opposed to the extension of municipal trading to the sale of fittings, &c., and deprecated the running down of the companies.

Councillor Scott, of York, gave away the show when he suggested that if company directors would do their duty on municipal councils, they would, doubtless, manage better than small tradesmen; yet he somewhat illogically contended that "in every respect the municipalities were better than companies."

The paper by Mr. Councillor Panton, M.D., of Bolton, on "Electricity Supply and Methods of Stimulating Demand," did not provide the discussion that so practical a subject demanded. He dealt with the necessity for low prices and free wiring, suggesting another system which he called "assisted wiring," the tenant to pay as a quarterly rental 9 per cent. of the total cost for three years, when the installation would become his own. In our issue of May 22nd last, in an article entitled "The Art of Persuasion," we dealt with a much stronger inducement to tenants to become consumers, viz., offering an absolutely free installation of lamps, a scheme which we believe is working well in many places. The discussion on Dr. Panton's paper was limited to observations by Bailie Mackenzie, of Edinburgh, who advocated "a heavy load for street lighting, which was a standing advertisement," by Bailie Willock, of Glasgow, who favoured low prices, and Mr. McCowen, of Belfast, who explained that his Corporation had obtained Parliamentary powers to hire out motors, and that now contractors as well as the municipality were supplying motors on the same terms.

Mr. Joseph A. Jeckell dealt practically with his efforts to improve the position at Coventry, and Mr. Robert Hammond endorsed it, advocating the policy of boldly laying mains on a large scale as a most valuable one.

Mr. Jeckell incidentally alluded to one of the difficulties experienced by the electrical engineer in working a municipal undertaking, viz, the action of the Corporation committees in preventing them from carrying on the undertaking as they consider best. He has adopted important changes in the system at Coventry, especially in substituting two-phase distribution for the single-phase originally employed and largely increasing the outlay on mains. He would apparently have preferred altering the system throughout, but could not accomplish so drastic a remedy, as "it would have meant scrapping the generating plant, the transformers, and the meters, which, from a financial point of view, could not be done."

He says that: "it is well known that committees will frequently support the policy of a new manager, and agree to additions and alterations which, had they been proposed by the gentleman who had previously been manager, would not perhaps have commanded their support," and he apparently defends his predecessor by adding that "It is not, therefore, always just to think that a manager ought to have done what his successor has been able to accomplish."

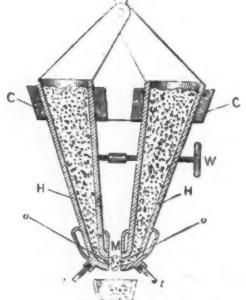
Mr. Jeckell pointed out that "the idea that it is derogatory to the dignity of the electrical engineer to take up the *rôle* of 'bagman' is gradually finding its way into the limbo of forgotten things, and it is becoming recognised that to the chemist, the mechanic, the electrician and the accountant the would-be successful municipal electrical engineer must add a *soupçon* of the commercial traveller, spruce and up to date."

There is much truth in this phase of the commercial side of the municipal electrical engineer's duties, and it should not be lost sight of by local authorities when fixing the salaries of the Admirable Crichtons required for their undertakings; but this matter was not discussed at the Convention, although the President did suggest that engineers should not be tempted into drifting into the service of the companies.

ELECTRIC FURNACES.

THE June issue of *Cassier's Magazine* contains an article upon electric furnaces from the pen of Mr. J. Wright, in which the author describes and illustrates most of the types of furnace with which we are becoming thoroughly familiar. Among our old friends we recognise the arc furnace which is once more stated to be used at Neuhausen for the winning of aluminium by the Héroult (incorrectly spelt Hérault) process. It is safe to say that elementary aluminium never is, and never has been, made on a commercial scale by simple electric smelting of its oxide. In the early days of Neuhausen, Héroult, like the Cowles Brothers, prepared aluminium bronze in an electric furnace, probably of the type so often pictured; but after a very brief experience, the French inventor found it more desirable to make aluminium unalloyed with copper, and so he adopted the modern electrolytic cell in which the only thermal effect of the current is to maintain the bath in a fluid condition, reduction of the alumina, dissolved in molten cryolite, being effected by electro-chemical dissociation.

Among less known apparatus, the author figures the Chavarria-Contardo arc carbide furnace. Here a pair of parallel horizontal electrodes are fitted just above the hearth of the furnace, while over them are erected, ridge-roof fashion, a pair of carbon plates. The charge falls from overhead, and trickles down the inclined surfaces of the plates to the bottom of the apparatus, where the streams converge and pass just under the main electrodes, being "toasted" and converted into carbide. The carbon plates become strongly heated by radiation from the arc, and serve to heat the mixture of lime and coke during its descent. In the Frölich arc carbide furnace, attempts are made to employ the heat of combustion of the carbon monoxide produced to pre-heat the charge.



RUTHENBURG'S ELECTRO-MAGNETIC FURNACE.

One electrode consists of a truncated cone or perforated dish of carbon, the central orifice being the discharging orifice of the furnace. Vertically above this stands the other electrode, a hollow rod, the bore of which acts as a chimney for the gas. From its upper extremity pipes convey the carbon monoxide down to a space surrounding the lower electrode, where the gas is burnt to carbon dioxide.

A resistance furnace has been devised by Nernst and Glaser, based upon the principle of the Nernst lamp. The resistance or heater is cylindrical, electrical connection being made top and bottom by means of a packing of some conducting oxide, which is held in position with clamps. The hollow cylinder is loosely jacketed with oxide to prevent undue loss of heat. The heating cylinder is a mixture of magnesia, calcium carbonate, alumina and silica, and is closed with a lid, the substance under treatment being either placed directly in it or inside a crucible. In the former case, the cylinder is lined internally with pure magnesia coated with graphite to give it initial conductivity. Parker's resistance ingot carbide furnace "should have a decided future." It consists of a hollow upright cylinder of carbon, which forms one electrode, and a vertical rectangular rod of carbon, whose angles nearly touch the inner walls of the cylinder. The charge is fed in through hoppers into the segment-shaped spaces between the electrodes, the cylinder being given a constant rotary motion, and the central rod a slow, suitably-arranged lifting motion to stir up the contents of the furnace and to make room for the growth of the ingot.

Furnaces in which electrical resistance heating coupled with an air blast is used for the manufacture of metallic oxides and other comminated products are being frequently patented in the United States. Lomax's furnace, of this kind, is intended for the preparation of oxides of tin and lead. A refractory block has a narrow channel cut in its upper surface which constitutes the hearth, the channel merging at either end into a deeper and wider wedge-shaped cavity containing an electrode. Over the channel are fitted one or more jets delivering hot or cold air which impinges on the molten metal, oxidising it, and blowing the dust, &c., into an adjoining chamber for collection.

Ruthenburg's electro-magnetic furnace, illustrated herewith, has been designed for the preliminary treatment (*i.e.*, agglomeration) of iron-sand. It comprises a pair of cast-iron hoppers H, H, slung from a centre *a*, and capable of being moved nearer together or further apart at their lower extremities by operating the hand wheel W. Each hopper is fed at an equal rate with the finely-divided ore, which trickles down the hoppers, and becomes magnetised under the influence of the coils, C. These have their windings connected either in series with, or in shunt across, the hoppers, their office being to cause the individual particles of sand to cohere and so to form a self-supporting mass at M across the discharging apertures. Here maximum electrical action takes place, connections being made at *k* and *t*, and the semi-fused product then falls into the crucible, R. The discharge nozzles are water-jacketed as shown in the sketch.

Colbay, Ferranti, and Kjellin have independently patented resistance furnaces working on the inductive principle. They consist of an annular or helical channel in a refractory base, filled with a conducting or semi-conducting medium which constitutes the furnace charge, and which has a heavy current induced in it by a surrounding coil of many turns carrying an alternating current. This apparatus is said to be specially adapted to the fusing of metals like platinum, which are liable to occlude oxygen, &c., if melted in presence of air.

Fery's process for measuring the temperatures attained in an electric furnace is an application of Stefan's law that the radiation of an absolutely black body is proportional to the fourth power of its absolute temperature. An aperture is made in the wall of the furnace, and opposite it is erected a telescope with a fluorspar objective, which concentrates the heat received upon a small thermo-couple. By means of an inner diaphragm the number of rays reaching the thermo-element can be regulated, so that the device works independently of its distance from the furnace. The actual temperature is read on a specially prepared curve or table from the E.M.F., indicated by the thermo-couple. The fluorspar objective absorbs some radiant heat, and reduces the sensitiveness of the apparatus by about 10 per cent.; but the great range of the instrument makes it extremely useful. A somewhat cruder arrangement, which is liable to personal error, and is only available up to 3,600° F., consists of a telescope erected as before containing a glow lamp fed with current through measuring and regulating instruments. The furnace and the lamp are viewed simultaneously; if the lamp is cut out, its filament appears as a black line; if it is burning and is at a temperature equal to that of the furnace, the filament is invisible; if the filament is hotter than the furnace, it appears as a white line. The results are read on a specially prepared table.*

The author holds that the future is with the resistance rather than with the arc furnace. In the early days investigators were somewhat carried away by the idea of the almost illimitable temperature of the electric furnace, and they forgot that certain processes might be better suited by moderate temperatures. Moreover, a well-designed resistance furnace lends itself more readily than an arc furnace to exact heat regulation. So much power is now being consumed in electric furnaces—225,000 H.P. at the end of 1900, according to Wright—that improvements in the construction and working of these apparatus would be the means of saving large sums of money every year.

WHOLESALE PROFIT SHARING.

UNDER the title of "The Labour-Capitalist," Mr. F. C. Perkins makes a somewhat novel suggestion in the June number of *Cassier's Magazine*, for the total abolition of strikes and all labour troubles. He, like so many other writers at the present time, preaches the doctrine of salvation by profit sharing; but instead of proposing

* A very similar instrument for general photometry has recently been patented (English Patent 20,458, September 19th, 1902) by E. T. Turney, of San Francisco. A glow lamp is carried in a circular box, one end of which bears a translucent disc crossed by an opaque bar, the current supplied to the lamp being capable of regulation by rotating a collar on the box. The apparatus is used by presenting the outer surface of the disc to the light under examination, the glow lamp being employed as the standard. If the current is so regulated that the two lights are of equal intensity, all difference in appearance between the opaque and the translucent portion of the optical disc should vanish. It must be clear to anyone acquainted with precise photometry that the apparatus is excessively "crude."—EDS.

an original, or recommending a tested, method by which the workman shall receive his profits or his shares directly from the company or employer whom he serves, Mr. Perkins desires to make existing or improved trades unions the intermediaries in the transaction. Briefly, the workman of the future is to continue to pay periodical sums to his union; but instead of hoarding up the money or investing it in securities outside the industry in which the members are engaged, so as to form a fund for sick pay and (perhaps primarily) for strike pay—the union is to employ the funds in the purchase, at market rates, of ordinary stock of the concern or concerns with which its contributories are identified; purchasing the shares itself, but transferring them to the names of the men immediately each man has handed over a sum corresponding with one or more complete shares. Each man would, therefore, in time be a part, albeit small, proprietor in the company; and although his power to direct the management would be practically *nil*, if each gave his proxy to a representative of the union, the latter would be able to "vote the stock," and might acquire a seat on the board. This is not Socialism, says Mr. Perkins, for there is no common fund; and existing conditions would not be changed. The capitalist—using the word still in its present sense—would retain control of the situation, because he would still hold the debentures and the preferential stocks, so that his interest and dividends would be payable before the workmen's. The dividends of the men's stock would be available for sick funds; and at the death of a workman the union would buy out the widow or heirs in cash.

We have already expressed our sympathy with, and approval of, profit sharing under proper supervision and limitations. Profit sharing is most admirable when applied to high and low officers in an industrial enterprise—from managers to foremen; and it is no less admirable when applied to actual workmen of known stability and character. But it is only admirable, we take it, when freely offered by the proprietors and as freely accepted by the men without the interference of a third party—employers and employed should, and easily may, resemble man and wife, who equally resent outside criticism, whose quarrels only come before a judge or arbitrator in the last extremity, and who never benefit from the decision.

It must be clear, as Mr. Perkins argues, that if all men in a shop are shareholders, there will be no shirking of work, and foremen will no longer be required as simple "overlookers." But it is not clear why an employer should welcome a scheme whereby almost every employé automatically (so to say) becomes a shareholder, while retaining his right to transfer his services to a rival concern next week or month. As we understand it, profit sharing means that an employer examines his men carefully, notes those who are the most valuable and trustworthy servants, and offers them an additional incentive in the form of deferred payment to do their very utmost. But like all other benefits, it imposes obligations; it morally (not legally, of course) obliges the recipient to remain in his present employ to the end of his career—extraordinary causes naturally excepted. Moreover, the secondary (if not in reality the primary) function of profit sharing is to bring employers and employed into closer personal contact and sympathy; so that on the one hand the masters may see the dreariness of the men's lives and appreciate their views of things in general; and the men may learn how many factors besides the cost of labour and materials are involved in the maintenance of healthy trade.

Mr. Perkins's scheme tends to reduce the individual workman to a condition of less importance than that which he occupies now, making him more than ever a mere pawn in the game between the moving spirit of his Union, and his employer. Even if his employer be associated with a union of manufacturers governed *de facto* by one person, the latter's union will be vastly smaller than that of the men; and each single employer will remain a "piece" in the game. At the best, the men would give up their freedom to an organiser who, in his individual capacity, might be a man of intelligence, honour, and breadth of view; but who, as the "voter of stock," would refuse to approach with an open mind any question which threatened to reduce his constituents' immediate dividends. It is scarcely to be imagined that in such a responsible position as Mr. Perkins would give him—we write in the singular because "committees" are practically non-existent or non-operative—the trades union representative on the board could be brought to see the bearings of dim political and social troubles on his industry, and the desirability of increasing the reserve fund in times of national or international stress. At the worst, and workmen are not financial experts, Mr. Perkins's scheme would leave the workman at the mercy of his representative, who, singly or in conjunction with the inner ring of the union, might very conceivably indulge in ruinous financial operations, in company wrecking when in a fit of spleen, or even in actual dishonesty.

We have said nothing about the real legitimate risk to the workman's savings latent in Mr. Perkins's plan. The author cogently argues that an enterprise in which the capitalist is content to risk large sums should be safe enough for the man to risk small. It may be so; the employer's absolute risk is far greater than the men's. But the man risks his all; the employer only part—few millionaires, we imagine, have all their eggs in one basket. The risk argument, however, may surely be exaggerated; there is a risk in all investment, even in holding Consols. It should not be impossible to safeguard the men's investments; but very clearly the single profit-sharing employer knows the imminence and magnitude of the peril better than any trade union.

There is yet another point. It may be that in America, of which Mr. Perkins writes, trusts are becoming so ubiquitous that each branch of industry is under one control; and the facility for change of employment, at which we have hinted, may be practically non-existent on the part of the workman. But it does not follow that these trusts will persist indefinitely; it does not by any means follow that they will acquire and hold an equal footing in our country. In their absence labourers, even skilled mechanics and tradesmen, can actually change their employer repeatedly, so that, apparently, their unions must hold stock in every limited company engaged in the industry. No one, we assume, can prevent a trade union from buying stock in the market; but, if it do, and men become automatic shareholders irrespective of their merits, wages must suffer. Any employer may be willing, as he generally is now, to give increased remuneration to a specially valuable servant—in cash or in profits. If, however, he is virtually compelled to share his profits among the just and the unjust, he will offer two rates of wages; a high one to the non-unionist, calculated on the cash value of his services, and a low one to the unionist, leaving the latter to make good the difference from the interest on his investments. Profit sharing is only deferred bonus giving, and we see the effect of it in certain advertisements where the salary for such a post is stated to be put at such a figure because there is no superannuation allowance. It is foolish of an employer to cut down a man's wages simply because he is making more than so much a week, but the cutting down of unionists' wages because they are all recipients of deferred payments is totally different. If the employer were to pay an equal wage to the non-unionist and to the automatic profit sharer, assuming equal ability, he would be acting unjustly, and penalising the former, and he would be driving the men to the trade union for sympathy and protection, instead of attracting them to himself. It is all very well for Mr. Perkins to say his scheme is not socialism: but if a man forfeits his membership in his union by neglecting his payments, and if those payments are used to buy stock, all men (unionists) are treated alike, become shareholders in their employer's company to an equal extent, and, to put it negatively for politeness, they are not encouraged to work better or more intelligently than their neighbours.

CENTRAL ELECTRIC POWER STATIONS FOR GOLD MINES.

At a recent meeting of the Mechanical Engineers' Association of the Witwatersrand, a paper was read by Mr. J. W. Kirkland on the above subject. In advocating the centralisation of power as far as possible, the author did not claim that electricity was universally applicable for mining work. He excepted surface hoisting and rock drills. For the latter no electric drill could at present compete with air drills. The air drill was very inefficient, far less efficient than the worst electric drill that could be designed, but it did its work well. The essential features of a good drill are that hard blows shall be given, and the apparatus producing the blows shall be light.

Touching upon the question of recent practice in mining work, the author said the idea appeared to be that the power to raise stamps constituted the bulk of the power required in the mine, and high-class engines were put down for this work; whilst power extraneous to this received only secondary consideration.

The following is given as an analysis of the distribution of power in a 200-stamp mill crushing about 1,000 tons of ore per day :—

200 stamps at 2½ H.P. each	500 H.P.
1 60-ft. tailings wheel	25 „
Return water pumps	50 „
Cyanide works	75 „
Slimes	50 „
Disposal of tailings	100 „
Crushing and sorting	200 „
	1,000 H.P.

In addition to the above, it is necessary to provide for the shops, underground pumping, hoisting, lighting, mine ventilation, surface haulage (whether rope or electric locomotive), underground haulage, forges, &c. For all this, 1,000 H.P. is not excessive, so that the stamps take but one-quarter of the total power required.

After contrastidfi rope and compressed-air methods of transmission with electricity for hoisting and pumping, the author points out that for general surface distribution of power, electricity has no rival.

For stamp driving, the steam-engine system lacks flexibility, and in the early stages of working a mine, the engine is frequently loaded to only a fraction of its maximum power. It is, therefore, very inefficient, as it is necessary to provide engine power sufficient for all possible requirements.

With the electric drive, the power can be sub-divided and new motors added as additional stamps are required.

Another disadvantage of the steam-driven stamp mill is the necessity of placing the engine and boiler house close to the mill. Almost invariably this is a bad arrangement, as the requirements are different. For the mill, the essential requirements are proximity to the shafts, ample water supply and sloping ground if possible; whilst the power house should be near the railway line to permit of economical handling of coal, and should also be located on solid ground where good foundations can be got without much excavation. These two conditions are incompatible with those named for the mill. Electrical driving solves this difficulty at once. The power house may be situated in any convenient place, cable being carried from it to the mill, where low-speed motors may be erected to drive the cam shafts by belt, each motor driving 10 or 20 stamps. The number of stamps in operation can by this means be varied to suit the supply of ore, coal, labour, &c., as desired.

The mill provides a fairly steady load, and by permitting of the use of large generators, renders the plant more economical than if small-sized generators are used for other sections of the work only. It helps also to solve the underground hoisting difficulty, as the variable load is not felt so severely by the generators as it would be if the steady load provided by the mill were absent.

The author then deals with the important question of cost. Taking an average figure of £33 per stamp, the capital cost of cam shafting, clutch pulleys, &c., for a 200-stamp mill will be £6,600. This excludes erection. The cost of 20 low-speed motors, each of 25 H.P., is put down at £7,000, including delivery, which is only £400 more than the alternative shafting.

Foundations and supports for the shafting will cost as much as brackets or supports for the motors, and the erection of the latter will cost less than that of the former.

Touching the question of engine power, the author compares a triple-condensing Corliss engine with a combined turbo-generator. The engine, exclusive of foundations and erection, is put at £10 per I.H.P., whilst £9 per H.P. of generator output is taken for the electrical equipment. Delivery is included in both cases. As to efficiency, the author claims superiority for the turbine, owing to the flatter form of efficiency curve as compared with the Corliss engine. This is important if the plant works much below its rated power for long periods.

As to the efficiency of transmission, taking the efficiency of the generator as 94 per cent., of the cables (assuming 5,000 volts as the pressure) 98 per cent., transformers 98 per cent., low-voltage distribution 98 per cent., and low-speed motors 88 per cent., the total efficiency works out to 77½ per cent.

The efficiency, on the other hand, of line shaft driving would be from 80 to 85 per cent. But this difference cannot be debited against the electrical scheme, for, by adding the mill load to the general power system, the efficiency of the latter is improved. The labour item is reduced also. The system recommended is three-phase alternating, and this, no doubt, for mining work has much to recommend it.

An interesting discussion followed the reading of the paper, in which several of Mr. Kirkland's proposals were subjected to criticism.

Mr. Berry asked for further information about the lightning arresters proposed. He looked upon them in the same light as "burglar-proof safes" are regarded, just waiting for a good "crack" to come along to prove they are wanting. In his experience motors had been disabled by lightning, whilst the old-fashioned steam engines went on as usual.

Mr. Whittcombe pointed out the merits of gas engine driving for steady loads, such as driving batteries of 10 stamps, and considered that, when operated by power gas, they would be the most economical motor it would be possible to employ. The speaker advocated also gas engines for driving underground pumps, passing the exhaust gases through a cooler, thence to the surface through a wooden pipe. Comparing the costs, this speaker put the capital outlay on gas engines and producers at £10 10s. per H.P. for small sizes, whereas £29 to £30 would be the corresponding figure for electrical driving. This is made up thus:—Boilers, £6 to £7 per horse-power; turbo-generators, £9; motors, £14.

Steam Consumption of Turbo-Generators.

Touching the question of the relative economy of Corliss engines and turbines, the following figures of tests were given, which certainly disproved Mr. Kirkland's statement as to the great superiority of the turbine in point of better efficiency over a wide range of load.

In the tests referred to, the turbine was supplied with steam superheated 20° F., whilst the Corliss engine was supplied with saturated steam.

700-KW. reciprocating engine.		Elberfeld 1,000-KW. turbo-generator.	
Output.	Steam consumption per KW.-hour.	Output.	Steam consumption per KW.-hour.
		1,190 KW. (overload)	19·43 lbs.
711·3 KW. (normal)	21·5 lbs.	994·8 KW. (normal)	20·15 ,,
483·4 KW. (⅔ load)	20·3 ,,	745·3 KW. (¾ load)	22·31 ,,
293·9 KW. (⅖ load)	21·3 ,,	498·7 KW. (½ load)	25·20 ,,
		246·5 KW. (¼ load)	33·76 ,,

The figures for the turbines were confirmed by Mr. C. O. Schmitt, who gave also the results of a number of tests of Brown-Boveri-Parsons turbo-generators, from which we extract the following:—

Rated output in KW.	Speed r.p.m.	Voltage.	Steam pressure lb. per sq. in.	Type of condenser.	Test load in KW.	Steam consum. per KW.-hour.		Degrees of superheat.
						Saturated.	Superheated.	
400	3,000	2,000	126·5	Surface	400	23·14	21·82	73·8
					300	24·84	23·14	
					200	28·21	26·45	
					100	38·24	35·26	
200	3,900	2,000	177·5	Jet	200	—	21·14	105
					150	—	22·11	
					100	—	23·74	
500	3,000	300	142	do.	500	—	19·83	121·5
					375	—	21·82	
					250	—	24·46	
					150	—	31·08	
280	3,000	125	200 to 213	do.	280	25·2	—	
350	3,000	320	163·3	Surface	350	—	20·50	111
					262·5	—	22·44	
					175	—	25·52	
					87·5	—	33·77	
380	3,000	1,000	142	Jet	380	24·31	21·64	121·5
					190	—	24·24	
300	3,000	600	170	do.	300	24·91	—	
					150	27·77	—	
900	1,500	510	142	do.	900	—	21·16	121·5
					450	—	23·14	
180	3,500	550	134·9	do.	180	—	24·91	125
					150	—	25·35	
					100	—	27·11	

In addition to the above, over 40 sets of results of tests on Parsons turbines erected in various parts of England, and from these we extract the following:—

Name of station.	Test output in KW.	Speed in r.p.m.	Gauge pressure in lb. per sq. in.	Condenser pressure absolute in lb. per sq. in.	Degrees of superheat in ° Fahr.	St. consumption in lb. per KW. hour.
Newcastle ...	24·7	4,990	79·80	0·588	—	28·78
	11·8	4,430	72·99	0·490	—	33·9
Blackpool ...	52·7	5,044	125·8	0·98	—	27·99
	108·5	4,800	126·8	1·476	—	26·8
	51·4	4,600	126·8	0·93	—	29·88
W. Bromwich	123	3,500	128·8	1·079	54	25·5
	122	3,520	133·8	1·122	64	23·8
Blackpool ...	226	3,045	128·8	1·177	58	22·0
Scarborough	529	2,400	125·8	1·59	—	22·7
	258	2,400	127·8	1·13	—	26·4

At Dinwick the size and results are practically the same as at West Bromwich, and at Cheltenham and Blackpool the results with 500-KW. sets are very close to those given for Scarborough.

The result given below of a 1,000-KW. set at Newcastle is the best the author knows of, but, in his opinion, it is 3 lbs. per KW.-hour higher than would be the case for a reciprocating engine of the same size. At 20 per cent. overload the steam consumption was 18·03, and at full load 18·47 lbs.

per kilowatt-hour. The results with a Westinghouse-Parsons 1,500-KW. set were not so good as this, showing at 30 per cent. overload a consumption of 19·11, and at full load 20·21 lbs. per kilowatt-hour.

With De Laval turbines, the wear on the blades, due to the high velocity of the steam, appears to unfavourably influence the consumption. Thus it is stated in the July number of *Revue Mécanique*, 1902, that, after five years' work, a De Laval turbine showed an increased consumption of over 1 lb. per kilowatt-hour over the consumption when new.

A 200-H.P. De Laval turbine, with a steam pressure of 152 lbs. and condenser pressure of 0·367 lb. absolute, took at full load 20·626 lbs. per kilowatt-hour; and a 300-KW. set, with 160 lbs. steam pressure and 0·143 lb. condenser pressure, took 20·976.

Many of the above figures are taken from an article by Prof. Stodola, published in the *Z. d. V.D-Ing*, January and February, 1903.

THE GAS ENGINE AND ITS FUTURE.

THE commencement of the present century has been accompanied by such remarkable advances in the development of the gas engine as the principal prime mover of the future, that it is worth while even at this date to give serious consideration to the details of the large-unit class of engine now obtainable, together with its most profitable applications, in order to enable its suitability for power stations to be determined, as well as to record its present position in the economical development of power for the use of man.

Without attempting to review the history of the gas engine, it is interesting to note that it was at first applied to use such fuels as natural gas and retort gas, which, being more or less expensive or only obtainable in special positions, rendered the gas engine unavailable for the most ordinary demands for mechanical power.

This was followed by the application of producer gas to the driving of this class of engine; but though under the new conditions the fuel cost was cheapened, its applications were confined to comparatively small units of power under special circumstances. This was partly due to the irregular product of the producer when applied in single units, causing the running of the engine to be far from satisfactory for the ordinary power requirements of the day.

The advances in the application of electricity to industrial operations and lighting purposes excited a further advance in the producer, as well as the improvement of the gas engine as a motor capable of continuous and regular running.

While the number of gas engines driven by retort gas had reached a high figure, and producer-driven sets had very largely multiplied, it was probably the increase in the size of producer units, and their grouping, with the more uniform gaseous product resulting therefrom, associated with by-product recovery, which caused makers to attempt units of larger power and arranged for much more lengthy periods of continuous running.

However, though cheaper gas of more regular quality gave superior results in regard to installations of considerable dimensions with long periods of running, it was the discovery that the so-called waste gases from blast furnaces could be utilised as a source of power which brought about the greatest advance in the proportions of the power unit to be obtained by means of gas engines.

Mr. H. A. Humphrey, in his paper read before the Institution of Mechanical Engineers, December, 1900, in giving particulars of large gas engines, referred to cylinder diameters for Mond gas up to 28 in., while for natural gas the largest diameter was 34 in., but the application of blast-furnace gas brought the diameter of the gas engine cylinder up to 51 in. for practical use. This increase in cylinder diameter was not so much due to the decrease in the explosive power of the gaseous mixture employed, as to the necessity of increasing the unit of power available for practical application to industrial purposes with economy in regard to first cost, as well as to reduce the number of cylinders required for driving large dynamos and blowing engines.

Comparing the area of the cylinder of the Premier engine, designed for producer gas, with that of the Cockerill engine for use with blast-furnace gas, 28 in. diameter = 615·75 sq. in. area, 51 in. diameter = 2,042·8 sq. in. area, the ratio of increase of cylinder area being $3\frac{1}{3}$. This increase in the piston area will be better appreciated when it is pointed out that an engine working with coal gas only gives about 20 per cent. more power than when being driven with blast-furnace gas; it will be apparent from these figures that the application of producer and blast-furnace gas has had the effect of bringing the gas engine into a very prominent position as a power agent. It need hardly be pointed out that the size of the unit to be employed is only dependent upon the number of such large diameter cylinders assembled round the crank-shaft.

Following the possibilities in regard to the diameter of the piston in practical work comes the question of piston speed. For retort-gas engine practice it was up to late years found inadvisable to employ a piston speed above 700 ft. per minute, but with producer and blast-furnace gas the piston speed can be increased up to 900 ft. per minute. The increase of piston diameter associated with the increased piston speed will readily be appreciated as forming an advance not even thought of a few years ago.

The gas engine differs greatly from the steam engine in respect to the temperature inside the cylinder. Even with superheated steam this temperature is only low compared with that resulting from the combustion of the gaseous mixture in the cylinder of the gas engine, and this high temperature, associated as it is with high pressure, necessitates differences in the design of the cylinder and valves. To allow of lubrication and to keep the cylinder and piston from attaining an excessive temperature, water jacketing has to be resorted to, and pistons of large size also require to be kept cool by circulating water, owing to the effect of heat upon the lubricating medium. It is found that cast-iron rings of the Ramsbottom type are most effective in keeping the piston from allowing the gases to pass it during the explosion period, and in engines having valves situated in the region of the combustion of the gas, the mushroom type is found to be most effective. Slide and rotating valves have been tried, but with little success. Even when the valves are of the mushroom type it is found necessary to water-cool them when their proportions are considerable, as in the large engines now being employed.

The pistons are preferably of cast-iron of hard quality, and the piston rings are also cast-iron.

The gas engine cylinder consists, usually, of three main parts—the outer jacket, the liner of hard cast-iron, and the combustion chamber. The liner is generally so arranged that any considerable wear can be rectified by re-boring, and it is, for this purpose, so fitted that it can be readily removed from the jacket without causing the general framework of the engine to be disturbed.

The large gas engines we are dealing with in this article are assumed to be run with producer or blast furnace gas, as only very special conditions will allow of the application of coal gas, and natural gas is confined to more or less limited districts. Producer gas, if made from bituminous coal, and blast furnace gas, when coal forms the whole or part of the fuel employed in the furnace, are always accompanied by tar and dusty particles, and it is necessary that the gas should be rendered quite free from these if trouble in driving is to be avoided.

With the object of minimising the troubles arising from an accumulation of the fine dust particles carried by blast furnace gas when not thoroughly purified, the combustion chamber of the Cockerill engine has been so arranged that the exhaust valve is at the lowest part, with a fair-way from all parts where dust might collect, on the assumption that all the dust deposited will be carried out by the expansion and high velocity of the products of combustion.

The design of the Körting and Oechelhauser engines has not followed these lines, the gas having to pass through a pump cylinder on its way to the main cylinder.

In a paper read before the Institution of Electrical Engineers,* Mr. A. R. Bellamy gives a list of complaints against the gas engine :—

* "Large Gas Engines for Driving Electric Generators," by A. R. Bellamy, M.I.E.E., M.I.M.E., April 8th, 1902.

1. Unsteady driving.
2. Want of balance, and in consequence vibration.
3. Noise.
4. Difficulty in starting large gas engines.
5. Want of reliability.
6. Want of automatic lubrication, particularly on the bearings of the crankshaft and connecting rod.
7. Insufficient provision for preventing the oil from being thrown about.
8. Difficulty of working with "poor gas."
9. Want of speed.
10. Want of more powerful engines.

We need not take all these points into consideration, for the reason that the best makers of large gas engines now provide against most of them. If the makers are not willing to guarantee *steady* driving, then they will have little opportunity of getting their engines accepted for electrical purposes, but it will be seen later that even now a considerable number of large gas engines, applied to drive both continuous and alternating current generators, have been installed with very satisfactory results; balancing and prevention of vibration are also provided against, and the remaining points of the indictment are fully considered.

On the particulars of the power of the electrical generators to be driven, with the necessary cyclic and governing speed factors, being given to the manufacturers, they will readily decide whether one or a number of cylinders will be required, and the firms having a speciality of type will guarantee satisfaction on the points mentioned. With the horizontal Otto four-cycle single-acting single-cylinder, there will have to be provided a much heavier fly-wheel than when two or more cylinders are grouped. Following this come in turn the double-acting Otto-cycle engine and the double-acting two-cycle engines, with reduced cylinder sizes and floor area required.

The rapidly increasing application of gas engines for electrical power purposes and the development of the proportions of the units now being placed upon the market, compared with those of a few years ago, must obviously be due to important advantages possessed by this type of motor over the highly-developed steam boiler and engine.

The fact that a few power stations which originally started with gas engines and producers have since reverted to steam engines and boilers only goes to prove that the very considerable improvements which have taken place in size of unit, reliability, and especially in economy, are of very recent growth.

The high thermal efficiency of the gas producer and gas engine compared with those of the steam engine and its accessories, and the small stand-by losses, are probably the most notable advantages, resulting in economy of fuel and attendance, as well as in the cost of water, as almost any available quality of water will meet the requirements of the gas system, whereas impure water has very deleterious effects when employed in boilers. The attendance does not require to be of such a skilled quality, owing to the simplicity of the gas engine. No tall chimney stack is necessary, and the installation is not affected by variations in climatic conditions. The absence of smoke is also proof of there being no loss of fuel from this source; the highest efficiency being procured from every cubic foot of gas produced.

(*To be continued.*)

THE NECESSITY FOR PRECISION OF STATEMENT IN TECHNICAL WORK.

By H. M. HOBART.

It is generally admitted that every large engineering undertaking justifies heavy preliminary expenditures for the purpose of ensuring that the best results shall be obtained for a given outlay. Nevertheless, very important undertakings are frequently embarked upon without sufficient preliminary study, and on the basis of insufficiently considered statements. Even when the results are very satisfactory, it by no means follows that the best plan has been adopted. Confining our attention to schemes in which a large proportion of the total outlay is required for electrical plant, these contentions may be illustrated by alluding to several important questions which have been discussed extensively, but often very superficially. Amongst these may be enumerated:—

1. Is the use of steam-turbine-driven electric generators desirable at the present stage of development of turbines and high-speed electric generators?
2. Does the high economy of the gas engine justify its use for driving electric generators?
3. Are high speeds to be preferred to low speeds in piston-steam-engine-driven electric generators?
4. Are low frequencies to be preferred to high frequencies in alternating current systems?
5. Is the induction motor cheaper than the continuous current motor?
6. Is the rotary converter to be preferred to the motor-generator in sub-stations?
7. Can the use of the Nernst lamp lead to greater economy than the use of the vacuum incandescent lamp?
8. Is it economical to employ 220 volts instead of 110 volts for vacuum incandescent lamps?
9. Are vacuum incandescent lamps suitable for use on low frequency circuits?

Although it would be an exaggeration to assert that these questions would generally be answered emphatically by "Yes" or "No," such practice is only too common. There is no doubt whatever in the writer's mind that no single one of these or many similar questions could be thus satistorily answered. The answer to question No. 1 would first require at least the following information:—

(*a*) Is the electric generator required for continuous current or for polyphase currents?

(*b*) What is the capacity required per unit of plant?

(*c*) If the generator is for continuous currents, what is the voltage required; and if for polyphase currents, what may be the frequency?

(*d*) What is the lowest speed the turbine builders are prepared to provide?

Questions Nos. 2 and 3 would, for a carefully considered reply, also require at least as much additional information; but, the information obtained under headings (*a*), (*b*), (*c*) and (*d*), would in these three cases have relatively very different degrees of importance. Thus, under heading (*a*), if polyphase currents were required, this fact would weigh on the side of an affirmative answer to question No. 1, more especially if, under heading (*c*), it appeared that a very low frequency was undesirable; and, under (*d*), that the turbine manufacturers were prepared to provide a turbine of somewhat lower speed than present practice. But to thus drive medium frequency polyphase generators, gas engines are, on the whole, decidedly unsuited, and this consideration would weigh in favour of a negative answer to question No. 2, but this, of course, would again depend upon the type and speed of the gas engine and the economy attainable by its use. If, under heading (*a*), it appeared that a continuous current generator were required, this would weigh very strongly *against* an affirmative answer to question No. 1, especially if under heading (*b*) we learn that each unit should be of large capacity, these conditions, however, being fairly satisfactorily met by gas engines, especially if for very low speed.

There is a widespread belief that the higher the speed the lower is the cost of an electric generator. This generally ceases to be the case long before present customary turbine speeds are reached; but here, again, it depends upon the rated capacity of the unit, and especially upon whether it is for continuous or alternating currents, and in the latter case upon the required frequency. Hence we see at once the importance of having the information under heading (*d*).

For answering question 4, we must at any rate ascertain the type of prime mover which it is proposed to use, and even with that information there must be taken into consideration many other factors, such as whether the plant is for power or lighting work, and if the latter, whether the lighting is mainly (or to what extent) to be by arc lamps, incandescent lamps or Nernst lamps.

Question 5 is often answered promptly in the affirmative; but this, in the writer's opinion, is altogether without justification. It depends upon several factors, notably:—

1. The required speed in revolutions per minute.

2. The frequency of supply in cycles per second.
3. The voltage of supply.
4. The type of induction motor, whether slip-ring or squirrel-cage.
5. The rated output in horse-power.
6. The permissible power factor.
7. Whether variable speed is required.

The higher the values in (1) and (3) the greater is the inferiority of the continuous current motor, especially if (2) the induction motor's frequency is low, and if (4) the conditions permit of its being of the squirrel-cage type. Nevertheless (3), the commutator for the continuous current motor requires less material the higher the voltage; but this is offset (to a great though indefinable extent) by the large number of segments and connections and consequent increased labour cost, and also by the inherently more liberal proportions entailed from commutating considerations in high speed, high voltage continuous current motors. But it may broadly be stated that for a required high speed (1), a low frequency (2) squirrel-cage (4) induction motor of good power factor (6) will for, say, 50 H.P. (5) and 500 volts (3), be very much cheaper than a good 500-volt continuous current motor for the same output and speed. But a high frequency, say, 60-cycle, 500-volt, 50-H.P. slip-ring induction motor with suitable arrangements, in the interests of efficiency, heating and avoidance of wear, for internally short circuiting the slip-rings and raising the brushes, will, for a speed of 150 revolutions per minute, cost very much more than an excellent continuous current motor for the same speed, voltage and output, and will also have a poor power factor. Indeed, for large capacities, combined with high frequencies and low speeds, the ordinary type of induction motor is quite out of the question in comparison with continuous current motors, which latter are inherently at their best the lower the speed. For such conditions the

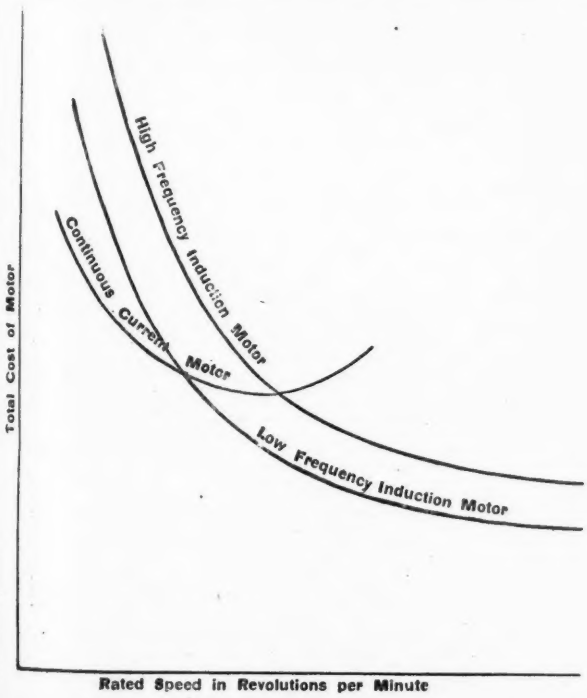

Total Cost of Motor
High Frequency Induction Motor
Continuous Current Motor
Low Frequency Induction Motor
Rated Speed in Revolutions per Minute

Fig. 1.

only hope for the induction motor is in the addition of a commutator according to the plan of Messrs. Latour and Heyland. For variable speed work (7), the induction motor may safely be said to be always inferior to the continuous current motor on the score of efficiency and cost. The curves of fig. 1 give a general idea of the relations of cost and rated speed for continuous current and induction motors.

Question No. 6 has been a most fruitful subject for discussion; and, although it is gratifying to note that the true status of the rotary converter in a distribution system is coming to be generally admitted, there are to be found recent instances where rotary converters are still being installed in the wrong place; thus may be mentioned their use in central stations side by side with high tension generating units of capacity hardly in excess of their own, where the energy supplied from the high tension units is fed through the stationary transformers and rotary converter to the neighbouring districts at some 8 per cent. lower efficiency than would have been obtained by a continuous current generating set. These rotary converters are also often still supplied with but three slip-rings, although for many years ample data have been available showing that by the use of six slip-rings and a proportionately larger commutator, 40 per cent. greater output may be taken from them for a given heating, hence permitting of greatly improved first cost and economy. It is still not well appreciated that a rotary converter designed to respond thoroughly satisfactorily to a compound winding, and thus, with moderate inductance in line or transformers, to permit of automatically maintaining the commutator voltage normal at all loads, or preferably to slightly over-compound, will then be operating at most loads at much less than unity power factor.

The seventh question, relating to the type of lamp, has been purposely introduced, as it is rather interesting to note the relation of type of lamp and choice of system. A most interesting contribution to the available data relating to the Nernst lamp is that of Mr. A. J. Wurts on the occasion of a topical discussion at the Cincinnati Electric Light Convention. Mr. Wurts, as the result of experimental data, quoted the average life of the Nernst lamp as follows:—1,200 hours at 133 cycles; 800 hours at 60 cycles; 400 hours at 25 cycles.

Should these results be borne out in practice, as there is no especial reason to doubt, they would evidently have a considerable influence on the choice of system, and would even justify the employment of frequency transformers or motor-generator sets to supply the lighting circuits, for if an average life of 1,000 hours could be obtained with a moderate priced lamp consuming but 2·0 * watts per C.P. during this life, as against from 3·5 to 4·0 watts per C.P., which is about the best obtainable for 110-volt 32 to 8-C.P. incandescent lamps of equal life, and 15 per cent. better than can be obtained in 220-volt lamps for that life, considerable saving could be demonstrated even with the increased expense of additional transforming apparatus and the loss of energy in this additional transformation. Then, again, as pointed out by Mr. Wurts, while the Nernst lamp shows but 11 per cent. drop in C.P. for 5 per cent. drop in voltage, the incandescent lamp shows a 40 per cent. drop in C.P. for a 5 per cent. voltage drop,† and hence arises great difficulty and expense in obtaining satisfactory results in incandescent lighting from alternating current circuits. So with respect to question 7, one would wish also to ascertain whether the lamps are to be supplied from alternating or continuous current circuits;‡ the frequency of the supply; whether rotating apparatus in sub-stations would be permissible, or whether the transformation must be by means of stationary transformers. These, of course, would by no means exhaust the necessary inquiries, but would contribute toward an intelligent answer.

(To be concluded.)

TRADE UNION TYRANNY.

A CASE which was recently heard at the Manchester Assizes serves to illustrate once more the enormous benefits conferred on the public by the principles of law applicable to trade unions, as recently laid down in the House of Lords. Formerly it was competent for trade union officials to order an employer to dismiss his workmen, or to prevent any "undesirable" from earning his livelihood by any means which best suited him; at the present time, however, not only can the party aggrieved bring suit in order to

* A far better economy than this is claimed for the Nernst lamp, and might be necessary, to give it a clear commercial advantage at its life at 25 cycles.

† Mr. Wurts's figure of 40 per cent. drop in candle-power for vacuum incandescent lamps, for a 5 per cent. voltage drop, is very high. It ranges, in practice, down to only 25 per cent. drop.

‡ For the recognised inferior voltage regulation on alternating current distribution networks, fed from static transformers, would render the less sensitiveness of the Nernst lamp to variations in voltage, a more important consideration on alternating current than on continuous current circuits.

obtain redress, but the union funds can be attached to answer damages.

Let us look at the facts of the case under notice. The action was brought by one James Carr, a master painter and decorator, against the National Amalgamated Society of House and Ship Painters and Decorators and one Frank Lowe, their "walking delegate," to recover damages for loss sustained by reason of their having conspired to induce certain workmen to break contracts which they had entered into with him. It appeared that in September, 1901, the plaintiff undertook work for a firm who had contracted with the Salford Corporation Tramways Committee for the painting of street poles. For some reason, with which Mr. Carr was not directly concerned when his men entered upon that work, the Society, represented by their walking delegate, came forward and peremptorily ordered the men to stop work. It subsequently transpired that Mr. Carr had been made a victim on account of some dispute which the Society had with the head contractors. The plaintiff protested at the time, but put his men on to other work in order to minimise his loss. In January, 1902, Carr took into his employment, as foreman, a non-society man named Ross, and this fact was reported to the defendant Society's local secretary by Lowe. Carr was then at work painting the stations on the Manchester South Junction & Altrincham Railway. The local secretary then addressed the following letter to the defendants' general secretary:—"I am directed to ask the Executive Council for power to withdraw men from Carr's shop of Waterloo Road, the said Carr having influenced one of his foremen, named Ross, to join a so-called provident society and leave ours." In the event, the plaintiff's men were called out, and the defendants even went so far as to provide funds to enable their local secretary to write others, not belonging to the society, to leave Carr's employment.

Nor was this all. The plaintiff commenced negotiations to do certain work for the Manchester Corporation; but when the fact was reported to Mr. Lowe, he made such representations to the Corporation that they elected to do the work themselves, by reason of which the plaintiff suffered loss. Then plaintiff further alleged that wherever he sought employment he was hounded down by this society. People rejected his tenders as soon as they found out that immediately the work was entered upon his men were liable to be called out. He proved that his turnover decreased in consequence of the defendants' conduct from £3,495 in 1900 to £2,943 in 1901 and £2,721 in 1902.

At the conclusion of the case, the hearing of which lasted two days, the Commissioner of Assize left the following questions to the jury:—(1) Did Lowe knowingly and for his own ends, or the ends of the defendant society, (*a*) procure Carr's workmen to break their contracts of employment with him in the Salford case; (*b*) did he do so with the authority or by direction and on behalf of the defendant society; and (*c*) was there any, and what, sufficient excuse for the defendants in so doing? (2) Did the defendants maliciously, and with the intention of injuring the plaintiff, conspire to induce and procure, and did they induce and procure the plaintiff's workmen then working for him at Knot Mill station to leave and continue away from their employment? (3) Did they conspire to induce, and did they induce the two men Walmsley and Miles to leave their employment? (4) Did they maliciously, and with the intention of injuring the plaintiff, conspire to induce and procure, and did they induce and procure Bullivant & Sons to refuse to accept the plaintiff's tender for the contract for painting at the Hyde Road tramway shed? (5) Did the defendants maliciously, and with the intention of injuring the plaintiff, conspire to prevent or obstruct the plaintiff, and did they prevent or obstruct the plaintiff from or in carrying on his trade of painter and decorator? The jury answered all the questions, except the first, in the affirmative, and subsequently assessed the damages at £322. On an application for a stay of execution with a view to an appeal, the counsel for the defendants made the sinister observation "that it was doubtful whether the union funds could be got at for the purpose of answering damages." His Lordship entered judgment for the plaintiff, and also granted him an injunction.

The sordid story unfolded during the course of this case is but a repetition of what has been frequently enacted in the past. Unfortunate men upon whom, in many cases, there have been defenceless women and children dependent, have been hounded from one place to another at the imperious will of trade union officials, against whose tyranny the law has heretofore provided no redress. To the credit of our English system of jurisprudence, a remedy has now been found for grievous wrongs of this kind. Not only may actions be brought, but the union funds may be attached to answer damages for the wrongful acts of the officials of the union; and we trust that, however artful the officials may be to evade payment, the arm of the law may be long enough to reach the union funds for the purpose of paying compensation to the plaintiffs who are the victims of such tyranny.

NEW PATENTS APPLIED FOR, 1903.

Compiled expresaly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

15,968. "Improvements in electric batteries." A. Blackman and C. E. Warren. July 20th.

15,970. "Improvements in and connected with electric tramcars." J. A. Lycett and G. J. Conaty. July 20th.

15,972. "Improvements in switches and rheostats for starting and controlling electric motors." F. O. Hunt. July 20th.

15,975. "An improved suspender for carrying balance weights, used as electric lighting accessories." R. T. Grocott. July 20th.

15,979. "An improved switch lamp-holder for electric lighting." G. Casperson. July 20th.

15,980. "Indicating attachment on electric fuse ways." J. Wilson. July 20th.

15,992. "Electro-magnetic brake for electrically-propelled cars of tramways and street railways." H. Seggel. July 20th. (Complete.)

16,014. "Improvements in casings for electric conductors." W. V. Smith. July 20th.

16,036. "Improvements in apparatus for regulating the supply of current in electric mains." H. W. Butler. July 20th.

16,078. "Improvements in and relating to electricity motor-meters." W. Hamilton. Dated July 21st.

16,100. "Improvements in circuit-controlling devices, chiefly designed for use with electric flash signs." H. H. Lake. (Automatic Time Switch Co., United States.) July 21st. (Complete.)

16,114. "Improvements in interrupters for use with induction coils and other electrical apparatus." J. N. Maskelyne. July 21st.

16,115. "Improvements in electric system of fire alarm and signalling apparatus." F. Hubber and W. G. Higgs. July 21st.

16,132. "Improvements in and relating to rectifying polyphase alternating currents by means of unipolar cells." W. E. Evans. (Allgemeine Elektricitäts Gesellschaft, Germany.) July 21st. (Complete.)

16,138. "Improvements in electrical signalling systems for railways." C. W. Mills and W. W. Piddington. July 21st. (Complete.)

16,142. "Improved switch-hook for telephones." R. F. Hall and T. L. Jones. July 22nd.

16,148. "An improved fuseboard for any number of ways." A. Reame. July 22nd.

16,159. "Improvements in or connected with electric measuring." A. T. Cooper. July 22nd.

16,190. "Improvements relating to tension-limiting devices for electrical apparatus." H. H. Lake. (Compagnie de l'Industrie Electrique et Mecanique, Switzerland.) July 22nd. (Complete.)

16,232. "Improvements in the manufacture of electrical resistances." T. E. Weaver. July 23rd.

16,258. "Improvements in rotors for electrical machines." A. G. Brookes. (Electricitäts-Gesellschaft Alioth, Switzerland.) July 23rd. (Complete.)

16,294. "Improvements in electric arc lamps." H. Beck. July 23rd. (Complete.)

16,300. "A coupling for wires, cables, and the like adapted for use both for mechanical and electrical purposes." J. E. Spagnoletti. July 23rd.

16,360. "Improvements in means for breaking electric circuits." C. B. Auel and J. R. Spurrier. July 24th.

16,366. "Improvements in electric lamps for cycles, motor-cars and other road vehicles." S. Goodman. July 24th.

16,388. "An improved tumbler switch for electrical purposes." Veritys, Ltd., and D. E. Rogers. July 25th.

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5,512. "Improvements in electric cables." G. G. M. Hardingham. Dated March 5th.

6,306. "Improvements in systems of electric alarm signals for railways." W. P. Thompson. (Penza.) Dated March 14th.

6,473. "Improvements in wireless telegraphy." G. L. Hogan. Dated March 17th.

6,760. "Improvements in means for making fluid-tight joints between two bodies and for aligning the axes of the same for electrical and other purposes." W. McLellan. Dated March 19th.

7,080. "An improved electrical measuring instrument." W. M. Thornton. March 22nd.

7,216. "Improvements in pipes or conduits for electrical conductors." G. C. Hurrell. Dated March 25th.

7,486. "Improvements in speed-regulating devices for dynamo-electric machines." British Thomson-Houston Co., Ltd. (F. T. Erben.) Dated March 27th.

7,665. "An improvement in dynamo-electric machines and motors." Siemens Bros. & Co., Ltd., and J. G. Wilson. Dated April 1st.

7,824. "Improvements in supports for incandescent electric lamps." A. Romain and J. D'Ayguesvives. Dated April 3rd.

7,958. "Improvements relating to guard and trolley wires for electric tramways." J. T. Pearson. Dated April 5th.

8,121. "Improvements in or relating to electric lighting of railway or other vehicles." M. Buttner. Dated April 7th.

8,323. "Improvements connected with up and down swinging brackets, arms, rods, holders, carriers, and such like, particularly applicable for gas, oil, electric light fittings, for displaying articles in windows." E. Townshend. Dated April 10th.

8,503. "Improvements in and relating to electrical measuring instruments." C. W. Atkinson. Dated April 11th.

8,548. "Improvements in electric switch fuses." H. H. Berry, P. F. W. Simon, and E. Skinner. Dated April 12th.

9,865. "Improvements in electrical ignition devices for internal combustion engines." R. S. Lovelace. Dated April 29th.

8,892. "Improvements in and relating to electrically wound clocks." H. H. Lake. (Aktiebolaget Svenska Elektriska Urfabriken.) Dated April 16th.

9,531. "Improvements in electricity demand meters." G. Byng and E. Sayer. Dated April 24th.

9,873. "Improvements in and relating to the connections or joints of cables for conveying electrical energy." A. G. Brookes. (Thompson.) Dated April 29th.

9,899. "Improvements in apparatus for making aerated beverages and automatically and electrically controlling the gas pressure therein." P. E. Malmstrom. Dated April 29th.

10,022. "Improvements in shuttles employed in connection with electric slip motions and automatic shuttle changing motion of looms for weaving." R. Slack. Dated May 1st.

10,271. "Improvements in apparatus for automatically supplying electric power to operate mechanism in clocks and other instruments or machines." H. Scott. Dated May 5th.

10,899. "Improvements in electric circuit protecting devices." S. Z. de Ferranti and C. C. Garrard. Dated May 12th.

10,938. "An improved electric switch." W. White. (F. Rohr.) Dated May 13th.

11,086. "Improvements in and relating to electric switches." D. R. Broadbent. Dated May 14th.